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FROST PROTECTION OF FERNS BY SPRINKLER IRRIGATION

By RAY T. SHEROUSE

[Weather Bureau, Lakeland, Fla., July 1938]

Considerable attention has been given by growers to the matter of frost protection by irrigation. Many attempts have been made to protect orchard trees by sprinkling with water with disastrous results since the weight of the ice formed on cold nights usually is greater than the trees can bear and the resultant damage by breakage generally is greater than the damage caused by the frost on unsprinkled trees. Experiments conducted by the Florida Horticultural Protection Service have shown that it is possible to protect certain ground crops from frost damage against severely low temperatures by sprinkler irrigation. Observations as to the effectiveness of this method of frost protection are presented in this discussion.

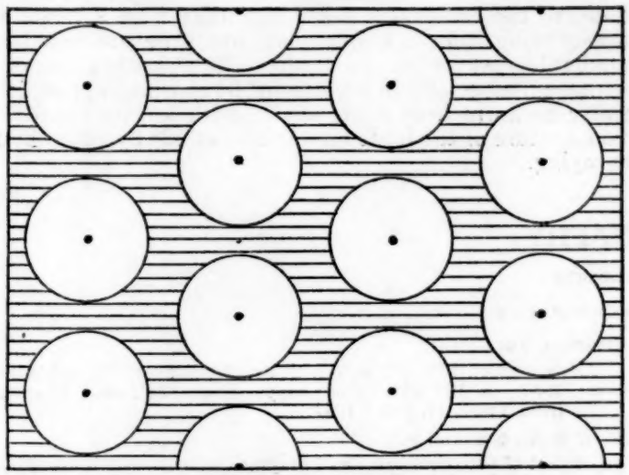

FIGURE 1.—Section of fernery showing how sprinklers were placed. Unshaded circles show area adequately protected by each sprinkler. Shaded portions show area where ferns were damaged. Sprinkler heads were 30 feet apart and radius of coverage was 12 feet.

Protection of ferns from frost damage by spraying water continuously upon the plants during periods of damaging temperatures was attempted on a plot of ferns during the cold weather of the 1937–38 winter season in Florida. The ferns were of the asparagus plumosus variety, used extensively by florists. The test plot was located in the Peerless fernery of the Winter Park Fernaries, Inc., at Fern Park, Fla. Ten of the fourteen acres in the Peerless fernery were equipped with oil heaters for protection against damaging temperatures. The four-acre test plot was not equipped with heaters and was separated from the rest of the fernery by a high board fence which isolated it from the heated area. The test plot was located in the northern part of the fernery, which made the effect from the heaters in the other plot too small to be of consequence since the nocturnal air drift was mostly from the north. Revolving sprinklers were arranged 30 feet apart in 30-foot rows in staggered formation. Water for irrigation was pumped from a nearby lake through underground mains. At the time of installation the sprinklers had not been placed close enough together to completely cover the intervening spaces with water spray, and a space of from 4 to 8 feet in the center between each two sprinklers was not consistently covered. The relative positions and coverage of the sprinklers are diagrammed.

On the morning of December 7, when the temperature inside the fernery had fallen to 33° F. at 1 a. m., the sprinklers were set in operation. Ice began covering the ferns very soon as the temperature continued to fall rapidly. The temperature at the station outside the fernery fell to 23.4° F. with a duration of 9½ hours at 32° and below. Before sunrise the entire plot was covered with ice which did not entirely melt throughout the following day, and the irrigation was kept going continuously. On the next morning, the temperature at the outside station fell to 24.0° F., with 13¼ hours at 32° and below. December 8 was a much warmer day and by late afternoon all the ice in the fernery had melted and the irrigation pumps were shut down after being in continuous operation for more than 40 hours. About an hour after the irrigation was started a thin coating of ice had formed over the fronds on each runner and ice continued to form all night. It was found that the ice had formed long icicles as the water sprinkled on top of the ferns dripped downward. The ferns were in nearly normal position due to the structural support given by the ice girders and had not been pressed to the ground by the weight of the ice, as might have been expected. A small amount of displacement does little damage to this variety of fern, which has tough pliable stems.

A few days later the fernery was examined for frost damage. Around each sprinkler for a radius of about 12 feet the ferns were in good condition and it was difficult to find a spray which showed any sign of frost damage. Damage in this area was less than 5 percent. The space between sprinklers where the coverage was not good or entirely lacking received 75 to 100 percent damage. The area of damaged ferns appeared as a ring outside a radius of about 12 feet from each sprinkler head. This radius was slightly variable due to the covering efficiency of the individual sprinklers.

The ferns in an unprotected nearby fernery were a total loss. The minimum temperature at this fernery on December 7 was 26.1° F., with 9 hours at 32° and below; and on December 8 was 27.6° F., with 12¾ hours at 32° and below. These temperatures were not as low as at the Peerless fernery.

An interesting sidelight on the experiment appeared in another nearby fernery. The same irrigation mains served both ferneries and when the pumps were started at 1 a. m. on December 7 at the Peerless fernery, the mains

and sprinklers in a portion of the other fernery had not been closed. All of this fernery was equipped with oil heaters for frost protection and when the lighting of the heaters was begun, it was discovered that some sprinklers were operating. At that time, ice was just beginning to appear on the wet ferns. The sprinklers were turned off immediately and the heaters were lighted and burned throughout the period of damaging temperature. A few days after the cold spell, in the section where the irrigation had operated before heaters were lighted the ferns were a total loss for a space of about 12 feet around each sprinkler. In the spaces between sprinklers where the ferns had not been wet the damage was about 20 percent. The remainder of the fernery, which received no irrigation, also had damage of about 20 percent which was due to delay in getting the heaters lighted. According to this it appears that once spraying is begun it must be continued without interruption during the period of damaging cold.

In the cold spell of January 27, 28, and 29 the same method of protection was again used in the 4-acre plot of the Peerless fernery. At this time there was a good crop of ferns throughout most of the plot. On the morning of January 27, the temperature in the outside station reached 26.3° F. with 3¼ hours at 32° and lower. On the morning of January 28, the temperature reached 26.5° F., with 4 hours at 32° and lower, and on the morning of January 29, it reached 26.3° F., with 11¼ hours at 32° and lower. On each morning the sprinklers were started just before the temperature inside the fernery reached 32° and were continued into the next day without interruption, until all the ice had melted.

The fernery was again examined for frost damage a few days after the cold spell had ended. Damage again was confined to the unsprinkled area about halfway between sprinklers; the loss here was 75 to 100 percent. Around each sprinkler for a radius of about 12 feet it was difficult to find a frond which showed any sign of damage.

The operating expense was very small. The equipment had been installed for the purpose of irrigating during dry weather, and the cost for upkeep and depreciation could be divided for this reason. The principal item of expense was for electric power to operate the pumps, which was figured to be less than $1 per hour for the 4-acre plot. With additional sprinklers per acre the cost would have been very slightly higher.

The manager of the Peerless fernery, Hibbard Casselberry, states that he has practiced sprinkler frost protection with success in different ferneries at different times. He states that his only difficulty with this type of frost protection has been due to power failure, since a break-down while the ferns are covered with ice usually results in a complete loss of the crop. In his opinion, the type of soil is also important, and the method is better adapted to sandy soil of thirsty nature. In heavy soils, the large amount of irrigation water which is sometimes required might do considerable damage to the plants.

Attempt is not made to draw any sweeping conclusions from the results of this experiment since a much greater amount of data should be accumulated before generalizations are made. The facts brought out may be taken to indicate the reasonable possibility that frost damage to low-growing, tough, woody plants may be prevented at moderate cost by means of sprinkler irrigation properly managed, especially in the case of ferns which apparently suffer no harm from being coated with ice, provided the temperature of the ice is maintained at 32° by continuous spraying.

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[RICHMOND T. ZOCH, *in Charge of Library*]

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SOLAR OBSERVATIONS

[Meteorological Research Division, EDGAR W. WOOLARD in charge]

SOLAR RADIATION OBSERVATIONS, MARCH 1939

By CHARLES M. LENNAHAN

Measurements of solar radiant energy received at the surface of the earth are made at eight stations maintained by the Weather Bureau, and at nine cooperating stations maintained by other institutions. The intensity of the total radiation from sun and sky on a horizontal surface is continuously recorded (from sunrise to sunset) at all these stations by self-registering instruments; pyrheliometric measurements of the intensity of direct solar radiation at normal incidence are made at frequent intervals on clear days at three Weather Bureau stations (Washington, D. C., Madison, Wis., Lincoln, Nebr.) and at the Blue Hill Observatory at Harvard University. Occasional observations of sky polarization are taken at the Weather Bureau stations at Washington and Madison.

The geographic coordinates of the stations, and descriptions of the instrumental equipment, station exposures, and methods of observation, together with summaries of the data, obtained up to the end of 1936, will be found in the MONTHLY WEATHER REVIEW, December 1937, pp. 415 to 441; further descriptions of instruments and methods are given in Weather Bureau Circular Q.

Table 1 contains the measurements of the intensity of direct solar radiation at normal incidence, with means and their departures from normal (means based on less than 3 values are in parentheses). At Madison and Lincoln the observations are made with the Marvin pyrheliometer; at Washington and Blue Hill they are obtained with a recording thermopile, checked by observations with a Marvin pyrheliometer at Washington and with a Smithsonian silver disk pyrheliometer at Blue Hill. The table also gives vapor pressures at 8 a. m. (75th meridian time) and at noon (local mean solar time).

Table 2 contains the average amounts of radiation received daily on a horizontal surface from both sun and sky during each week, their departures from normal and the accumulated departures since the beginning of the year. The values at most of the stations are obtained from the records of the Eppley pyrheliometer recording on either a microammeter or a potentiometer.

Direct radiation intensities averaged above normal for March at Washington and Lincoln, and slightly below normal at Madison.

Total solar and sky radiation was above normal at all stations with the exception of New York, Fresno, Riverside, Ithaca, and Newport.

No polarization observations were made during March.

TABLE 1.—*Solar radiation intensities during March 1939*

[Gram-calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
WASHINGTON, D. C.											
Mar. 3	3.30				1.25						2.26
Mar. 7	2.62			1.00	1.26		1.23				2.26
Mar. 8	1.68						1.12				1.68
Mar. 9	4.75				.95						5.16
Mar. 10	3.15				.96						3.45
Mar. 14	3.63	0.82	0.90	.98	1.11						3.00
Mar. 16	3.81			1.00	1.20						3.15
Mar. 17	3.15	.92	1.02	1.16	1.28						1.78
Mar. 23	3.81	.51	.58	.81	1.00		1.08				3.99
Mar. 24	4.95				.91						5.79
Mar. 29	3.15				1.17						2.36
Means		.75	.83	.99	1.11		1.14				
Departures		−.01	+.03	+.03	+.02		0				
MADISON, WIS.											
Mar. 1	1.24	1.05	1.17	1.30	1.46						1.68
Mar. 9	3.00			.89	1.26						3.00
Mar. 16	.96	.99	1.11	1.24	1.42	1.62					1.45
Mar. 19	2.16	1.01	1.09	1.22	1.38						4.17
Mar. 20	3.63	.94	1.05	1.17	1.28						2.87
Mar. 22	4.17	.53	.65	.80	1.09	1.36					4.95
Mar. 23	6.27	.67	.77	.95	1.17						7.04
Mar. 30	3.81					1.55					3.63
Means		.86	.97	1.08	1.29	1.51					
Departures		−.02	−.04	−.07	−.02	−.06					
LINCOLN, NEBR.											
Mar. 1	1.68		1.12	1.27	1.42						2.26
Mar. 2	2.62		1.05	1.20	1.39		1.40	1.20	1.04	0.92	3.45
Mar. 6	1.60	0.89	1.05	1.29	1.42		1.37	1.21	1.04	.94	2.62
Mar. 7	2.26				1.28						3.45
Mar. 13	4.37		.91	1.02	1.02		1.25	1.00	.86	.72	4.95
Mar. 15	1.68	1.00	1.11	1.25	1.44				1.11	1.01	2.16
Mar. 18	2.36		1.00		1.27						2.49
Mar. 20	3.81		1.09	1.20	1.39		1.24	1.12	1.00	.86	3.45
Mar. 21	4.17				1.24		1.20	.95	.76	.64	5.36
Mar. 22	4.57		.70	.93	1.17		1.26	1.07	.86	.73	4.57
Mar. 30	3.63	.81	.84	.94	1.28	1.59	1.37	1.20			4.95
Means		.90	.99	1.14	1.30	(1.59)	1.30	1.11	.97	.86	
Departures		+.06	+.05	+.05	+.02	+.04	+.02	+.02	+.03	+.05	

* Extrapolated.

TABLE 2.—*Average daily totals of solar radiation (direct+diffuse) received on a horizontal surface*

[Gram-calories per square centimeter]

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	San Juan	Friday Harbor	Ithaca	Newport
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Feb. 26	248	271	331	234	212	406	123	231	449	440	194	421	302	629	235	176	306
Mar. 5	336	287	322	223	212	342	163	299	474	458	396	455	301	604	243	153	261
Mar. 12	351	397	394	353	239	498	249	314	263	378	500	469	335	637	178	202	334
Mar. 19	469	429	463	392	397	403	240	464	241	446	432	196	465	595	366	305	474
Mar. 26	288	389	314	249	244	415	286	419	450	485	401	366	294	673	332	137	325
DEPARTURES OF DAILY TOTALS FROM NORMALS																	
Feb. 26	−36	−3	+6	+28	−34	+15	−17	−63	+117	+64	−86	+39	−3	+70	+70	−46	+19
Mar. 5	+35	−15	−18	+8	−43	−44	+1	−35	+168	+76	+75	+39	−4	+20	+39	−72	−34
Mar. 12	+41	+77	+24	+124	−19	+82	+45	−13	−56	−42	+148	+53	+49	+47	−15	−6	+2
Mar. 19	+129	+108	+67	+140	+93	−44	+44	+82	−107	−13	+63	−180	+72	+3	+112	+17	+82
Mar. 26	−57	+32	−67	−3	−35	−72	−6	+60	+28	+24	+80	−35	−94	+84	+19	−122	−73
ACCUMULATED DEPARTURES SINCE JAN. 1																	
	+1,813	+1,414	+196	+2,681	+161	−1,029	−238	−973	+2,751	+1,666	+3,941	−819	−406	+3,940	+1,575	−2,296	−456

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.) Superintendent, U. S. Naval Observatory. Data from measurements at the U. S. Naval Observatory from plates obtained at the observatories indicated. Difference in longitude is measured from the central meridian, positive toward the west. Latitude is positive toward the north. Areas are corrected for foreshortening and expressed in millionths of Sun's visible hemisphere. For each day, below longitude, latitude, area of spot or group, and spot count, are given respectively the assumed longitude of the center of the disk, assumed latitude of the center of the disk, total area of spots and groups, and total spot count]

Date	Eastern standard time	Mount Wilson group No.	Difference in longitude	Heliographic Longitude	Heliographic Latitude	Distance from center of disk	Area of spot or group	Spot count	Plate quality [1]	Observatory
1939	h. m.		°	°	°	°				
Mar. 1	11 39	6337	−80	171	+10	81	242	1	VP	U. S. Naval.
		6336	−58	193	+22	64	24	3		
		6333	−51	200	−19	52	145	1		
		6328	−6	245	−14	10	24	1		
		6334	+7	258	+22	29	48	3		
		6326	+9	260	−19	16	436	12		
		6325	+35	286	−20	38	121	1		
		6324	+38	289	+30	52	145	2		
		6320	+70	321	−7	70	242	10		
				(251)	(−7)		1,427	34		
Mar. 2	12 20	6337	−69	168	+11	71	242	3	F	Do.
		6338	−68	169	+13	70	24	2		
		6333	−38	199	−19	40	103	3		
		6328	+7	244	−14	10	24	1		
		6335	+20	257	+6	23	36	2		
		6326	+21	258	−19	24	485	15		
		6325	+48	285	−22	49	121	8		
		6324	+51	288	+30	61	145	4		
				(237)	(−7)		1,180	38		
Mar. 3	11 42	6337	−56	169	+10	59	242	15	F	Do.
		6338	−56	169	+13	60	48	3		
		6333	−24	201	−19	27	73	1		
		6326	+34	259	−19	36	388	9		
		6325	+60	285	−21	60	145	3		
		6324	+64	289	+31	71	97	2		
				(225)	(−7)		993	33		
Mar. 4	13 55	6337	−42	168	+10	46	291	12	P	Do.
		6338	−42	168	+13	46	97	8		
		6333	−9	201	−19	16	161	1		
		6326	+49	259	−19	50	291	1		
		6325	+76	286	−21	73	165	1		
		6324	+79	289	+30	86	97	1		
				(210)	(−7)		1,102	24		
Mar. 5	12 53	6337	−28	170	+10	34	218	15	F	Do.
		6338	−28	170	+13	35	73	4		
		6333	+13	221	−19	18	61	1		
		6326	+60	258	−18	60	291	8		
				(198)	(−7)		643	28		
Mar. 6	15 49	6337	−13	170	+10	22	218	15	P	Do.
		6338	−13	170	+13	24	73	2		
		6333	+19	212	−19	22	48	1		
		6326	+76	259	−18	74	291	4		
				(183)	(−7)		630	22		
Mar. 7	11 28		−56	116	−20	56	24	15	P	Do.
		6337	−1	171	+11	18	315	1		
		6338	+4	176	+13	21	24	1		
		6333	+30	202	−19	32	36	2		
		6339	+40	212	−10	40	61	1		
				(172)	(−7)		460	20		
Mar. 8	11 56	6341	−80	79	+12	82	194	1	P	Do.
		6337	+9	168	+10	19	388	17		
		6340	+20	179	−17	22	18	2		
		6333	+41	200	−19	42	48	1		
		6339	+53	212	−10	53	61	5		
				(159)	(−7)		709	26		
Mar. 9	10 53	6341	−65	81	+12	67	194	1	G	Do.
		6337	+21	167	+10	27	388	15		
		6340	+32	178	−17	33	121	7		
		6333	+53	199	−20	54	73	2		
		6339	+66	212	−10	66	48	3		
				(146)	(−7)		824	28		
Mar. 10	11 0	6344	−85	48	−17	84	242	1	P	Do.
		6341	−51	82	+12	55	73	1		
		6337	+33	166	+10	38	291	5		
		6340	+47	180	−17	48	97	5		
		6333	+68	201	−20	68	48	2		
				(133)	(−7)		751	14		

See footnotes at end of table.

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Mount Wilson group No.	Difference in longitude	Heliographic Longitude	Heliographic Latitude	Distance from center of disk	Area of spot or group	Spot count	Plate quality [1]	Observatory
1939	h. m.		°	°	°	°				
Mar. 11	11 2	6343	−69	51	+10	71	12	1	G	Mt. Wilson.
		6344	−69	51	−17	69	291	1		
		6341	−38	82	+12	42	97	1		
		6342	+2	122	−20	13	36	7		
		6337	+47	167	+10	50	291	7		
		6340	+60	180	−17	60	61	5		
		6333	+85	205	−20	73	24	2		
				(120)	(−7)		812	24		
Mar. 12	11 22	6345	−87	19	−9	87	48	1	G	Do.
		6344	−58	48	−17	58	291	1		
		6343	−55	51	+11	58	12	2		
		6341	−24	82	+12	30	73	1		
		6342	+14	120	−20	19	48	10		
		6337	+61	167	+10	64	242	4		
		6340	+74	180	−17	74	36	3		
				(106)	(−7)		750	22		
Mar. 13	11 5	6345	−73	20	−9	73	48	1	G	U. S. Naval.
		6344	−45	48	−17	46	291	1		
		6347	−40	53	−14	40	48	1		
		6341	−10	83	+12	21	73	1		
		6342	+24	117	−20	27	6	1		
		6346	+70	163	+11	72	170	6		
		6337	+75	168	+10	77	145	3		
				(93)	(−7)		781	14		
Mar. 14	10 58	6345	−60	20	−9	60	73	1	G	Do.
		6349	−35	45	−15	36	12	1		
		6344	−32	48	−17	33	303	1		
		6347	−28	52	−14	29	48	12		
		6348	−15	65	+12	24	18	2		
		6341	+2	12	+12	19	73	1		
		6346	+82	162	+12	83	48	1		
				(80)	(−7)		575	19		
Mar. 15	10 49	6345	−48	19	−9	48	73	3	VG	Mt. Wilson.
		6349	−22	45	−15	24	48	10		
		6344	−20	47	−17	22	315	2		
		6347	−17	50	−15	19	291	27		
		6350	0	67	+27	34	24	1		
		6348	+1	68	+12	19	36	3		
		6341	+14	81	+12	23	97	2		
				(67)	(−7)		884	48		
Mar. 16	11 18	6354	−77	337	−16	76	12	1	VG	U. S. Naval.
		6353	−74	340	−6	74	6	1		
		6345	−34	20	−9	34	97	2		
		6349	−8	46	−14	11	48	12		
		6344	−6	48	−17	13	291	1		
		6347	−2	52	−14	8	291	41		
		6348	+14	68	+11	23	6	6		
		6350	+16	70	+27	38	97	17		
		6341	+30	84	+12	36	85	3		
		6351	+63	117	−20	63	24	6		
				(54)	(−7)		957	90		
Mar. 17	12 11	6354	−63	337	−16	63	12	1	F	Do.
		6352	−56	344	+17	60	6	1		
		6345	−21	19	−9	21	61	1		
		6344	+8	48	−17	13	267	1		
		6349	+9	49	−13	12	24	2		
		6347	+12	52	−13	14	242	12		
		6350	+29	69	+27	44	242	15		
		6355	+40	80	−12	40	48	8		
		6341	+43	83	+14	48	73	1		
				(40)	(−7)		975	42		
Mar. 18	10 59	6359	−61	326	+15	65	145	5	F	Do.
		6354	−49	338	−16	49	12	1		
		6345	−6	21	−9	7	73	1		
		6344	+20	47	−17	22	291	1		
		6347	+27	54	−13	28	121	8		
		6350	+42	69	+27	53	97	8		
		6357	+48	75	+13	52	48	1		
		6355	+56	83	−13	56	145	10		
		6341	+59	86	+13	61	73	1		
				(27)	(−7)		1005	36		
Mar. 19	11 37	(*)	−54	320	+3	54	12	1	P	Do.
		(*)	−50	324	+20	56	12	1		
		6359	−48	326	+15	52	388	10		
		6354	−36	338	−16	37	12	1		
		(*)	−17	357	+9	23	36	2		
		6345	+9	22	−9	10	73	1		
		6344	+33	47	−17	35	339	1		
		6347	+39	53	−13	39	121	3		
		6350	+53	67	+29	64	242	8		
		6351	+61	75	+13	65	36	1		
		6355	+68	82	−13	68	242	9		
		6341	+69	83	+13	70	61	1		
				(14)	(−7)	.....	1574	39		

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Mount Wilson group No.	Difference in longitude	Heliographic Longitude	Heliographic Latitude	Distance from center of disk	Area of spot or group	Spot count	Plate quality [1]	Observatory
1939	h. m.		°	°	°	°				
Mar. 20	10 50	6362	−80	281	−23	78	24	1	G	Mt. Wilson.
		6359	−35	326	+13	40	436	15		
		6354	−23	338	−18	26	12	2		
		6353	−22	339	−7	22	48	5		
		6360	+19	20	+17	30	48	4		
		6345	+20	21	−10	21	73	1		
		6344	+46	47	−19	47	291	1		
		6347	+54	55	−13	54	145	1		
		6350	+68	69	+28	74	194	4		
		6357	+77	78	+13	78	24	1		
		6355	+81	82	−12	80	242	10		
		6341	+82	83	+12	83	48	1		
				(1)	(−7)	-------	1585	46		
Mar. 21	11 6	6364	−69	279	+31	76	48	3	P	U. S. Naval.
		6363	−66	282	−15	65	6	2		
		6362	−65	283	−23	65	36	1		
		6361	−35	313	−8	35	12	5		
		6359	−20	328	+15	30	436	13		
		6353	−9	339	−7	9	18	4		
		6360	+32	20	+17	39	12	3		
		6345	+34	22	−10	34	73	2		
		6344	+59	47	−18	58	194	1		
		6347	+65	53	−13	64	242	10		
		6350	+80	68	+27	88	145	3		
				(348)	(−7)	-------	1222	47		
Mar. 22	12 9	6364	−56	278	+30	65	48	1	F	Do.
		6367	−55	279	+2	56	6	1		
		6362	−52	282	−23	53	24	1		
		6361	−24	310	−9	24	6	1		
		6366	−8	326	−8	9	6	4		
		6359	−7	327	+15	22	436	19		
		6353	+4	338	−7	4	48	10		
		6365	+5	339	+21	29	12	2		
		6345	+49	23	−9	49	18	1		
		6344	+72	46	−17	71	388	1		
		6347	+79	53	−14	78	630	20		
				(334)	(−7)	-------	1622	61		
Mar. 23	11 8	6364	−43	278	+31	56	48	3	P	Do.
		6362	−39	282	−23	41	36	1		
		6361	−9	312	−9	10	121	12		
		6359	+6	327	+15	22	436	8		
		6353	+17	338	−7	17	73	4		
		6345	+60	21	−9	60	6	1		
		6344	+85	46	−18	81	339	1		
		6344	+85	46	−14	81	194	1		
				(321)	(−7)	-------	1253	31		
Mar. 24	11 4	6364	−31	277	+33	50	24	15	VG	Do.
		6362	−27	281	−24	32	12	2		
		6363	−27	281	−15	28	12	8		
		6361	+5	313	−9	5	97	13		
		6359	+19	327	+15	29	291	20		
		6353	+33	341	−6	33	97	13		
				(308)	(−7)	-------	533	71		
Mar. 25	11 7	6364	−19	276	+31	42	36	4	P	Mt. Wilson.
		6362	−14	281	−23	21	24	2		
		6363	−13	282	−14	16	24	5		
		6368	+11	306	+9	19	12	1		
		6361	+18	313	−9	18	73	20		
		6359	+31	326	+14	37	267	15		
		6366	+33	328	−2	34	12	1		
		6369	+41	336	−18	42	24	2		
		6353	+47	342	−6	47	36	5		
				(295)	(−7)		508	55		
Mar. 26	12 44	(*)	−35	246	−7	35	24	6	VG	U. S. Naval.
		6364	−7	274	+31	39	18	5		
		6262	−1	280	−23	17	24	2		
		6361	+33	314	−9	33	388	41		
		6359	+46	327	+15	50	242	18		
		(*)	+46	327	+21	52	6	3		
		(*)	+74	355	+12	76	36	1		
				(281)	(−7)		738	76		

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Mount Wilson group No.	Difference in longitude	Heliographic Longitude	Heliographic Latitude	Distance from center of disk	Area of spot or group	Spot count	Plate quality [1]	Observatory
1939	h. m.		°	°	°	°				
Mar. 28	13 50	6372	−34	220	+7	37	12	3	VG	U. S. Naval.
		6371	+13	267	+7	20	36	7		
		6361	+61	315	−9	61	242	15		
		6359	+74	328	+17	77	194	1		
				(254)	(−7)		484	26		
Mar. 29	9 43	6373	−79	164	+10	80	6	1	P	Mt. Wilson.
		6372	−21	222	+7	25	12	1		
		6371	+26	269	+7	30	24	4		
		6361	+74	317	−9	73	194	5		
				(243)	(−7)		236	11		
Mar. 30	12 23	6373	−65	163	+9	67	24	1	P	Do.
		6372	−6	222	+7	15	12	2		
		6370	+39	267	−16	39	48	3		
		6371	+43	271	+6	46	24	3		
				(228)	(−7)		108	9		
Mar. 31	11 18	6373	−51	165	+10	54	48	4	G	U. S. Naval.
		6376	−33	183	−15	35	12	6		
		6375	−2	214	−12	5	24	4		
		6374	+4	220	−13	7	36	7		
		6372	+8	224	+7	17	6	3		
				(216)	(−7)		126	24		

Mean daily area for 30 days=848.

[1] Plate quality.
*Not numbered.
VG, very good; G, good; F, fair; P, poor; VP, very poor.

PROVISIONAL SUNSPOT RELATIVE NUMBERS FOR MARCH 1939

[Dependent alone on observations at Zurich]

[Data furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich Switzerland]

March 1939	Relative numbers	March 1939	Relative numbers	March 1939	Relative numbers
1	*ad* 102	11	49	21	*Ec* 89
2	92	12	55	22	77
3	70	13	*Ec* 55	23	*a* 74
4	79	14	*a* --	24	*a* 66
5	----------	15	58	25	48
6	----------	16	*Wac* 55	26	49
7	*a* --	17	*Wac* 83	27	----------
8	*d* 44	18	*E* 112	28	35
9	*Mc* --	19	133	29	41
10	47	20	110	30	36
				30	35

Mean, 25 days=67.8.

a=Passage of an average-sized group through the central meridian.
b=Passage of a large group through the central meridian.
c=New formation of a group developing into a middle-sized or large center of activity: *E*, on the eastern part of the sun's disk; W, on the western part; M, in the central-circle zone.
d=Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL SUMMARY

[Aerological Division, D. M. LITTLE in Charge]

By B. FRANCIS DASHIELL

The results of 578 upper-air observations made in the United States, Canal Zone, and Hawaii, by airplanes and radiosonde during March 1939 are shown in tables 1 and 1a. Free-air pressures and temperatures, as well as the March resultant-wind directions and forces, are indicated on charts VIII, IX, X, and XI, and isentropic data are shown on chart XII. Tables 2 and 3 present certain selected observations obtained by pilot-balloons in the upper air. A detailed description of these data will be found in the January 1939 issue of the MONTHLY WEATHER REVIEW.

The weather in March was, in general, abnormally warm. Mean monthly temperatures at the surface (°F.) were above normal everywhere, except locally in the Northeast, upper Lake region, western Colorado, and the southern Pacific coast. Departures from normal were excessive by as much as +6° F. over the Middle Atlantic States and Ohio Valley, as well as the northern Rocky Mountain region. Precipitation was less than normal in the South, northern Great Plains, and west of the Rockies. Elsewhere, and particularly in the Northeast and in a belt across the country from the interior of the Middle Atlantic States to the southern Rocky Mountains, precipitation was unusually heavy.

In the lower levels of the free air (up to 5 kilometers) where observations are obtained both by airplane and radiosonde, most of the flights launched at the surface were very successful in reaching high altitudes. Of the 299 airplane observations made within the United States proper (table 1), 85 percent reached 5 kilometers, and 99 percent of the 217 radiosonde flights (table 1a) attained the same level. Ten kilometers was reached by 94 percent of the radiosonde observations; 55 percent went to 15 kilometers; and 24 flights (11 percent) over only 3 stations reached 18 kilometers.

An area of low atmospheric pressure prevailed during March over the Great Lakes region and along the St. Lawrence Valley eastward to Newfoundland, spreading northward indefinitely over the Hudson Bay area. This distribution is shown on charts VIII, IX, X, and XI. When compared to previous observations in the United States, this area exhibited slightly lower pressures than existed in March 1938. Elsewhere, however, pressures at 1.5, 3, 4, and 5 kilometers, were higher than a year ago, except over Washington, D. C., at all levels, and Pensacola, Fla., at 5 kilometers. Highest pressure prevailed during March over Pensacola, Fla., with slightly lower tendencies at El Paso, Tex., San Diego, Calif., and Oklahoma City, Okla., at all levels. Above 5 kilometers, where only radiosonde observations were obtained, pressures remained lowest over Sault Ste. Marie, Mich., and Fargo, N. Dak., at all levels. Computation of 5,000-foot pressures (chart VIII) for the western States, showed that a slight high-pressure area was centered over southwestern Colorado, and another over southern Nevada.

Sault Ste. Marie, Mich., reported the lowest free-air temperatures (°C.) at all levels below 5 kilometers, as shown on charts VIII, IX, X, and XI, and in tables 1 and 1a. Above 5 kilometers, the lowest temperature reported in March was −66.0° C. over Oklahoma City, Okla., at 17 kilometers. The second coldest station in the higher levels was Washington, D. C. Below 5 kilometers, highest temperatures prevailed over Pensacola, Fla., and at El Paso, Tex., at 1.5, 2, and 2.5 kilometers.

At 5 kilometers, Salt Lake City, Utah, was 8.0° C. warmer in March than during the previous month, and Fargo, N. Dak., Omaha, Nebr., Spokane, Wash., El Paso, Tex., Cheyenne, Wyo., and Billings, Mont., all were at least 5.0° C. warmer than in February. Also, the above stations, as well as others, except Fargo, N. Dak., and Omaha, Nebr., were warmer during the current month than a year ago in March 1938; Spokane, Wash., being as much as 6.8° C. higher. In the very high levels it was found that Oklahoma City, Okla., was warmer than in February up to 11 kilometers, and then colder above. In addition, Omaha, Nebr., and Sault Ste. Marie, Mich., were colder in March above 10 kilometers, and Fargo, N. Dak., was colder above 11 kilometers. Washington, D. C., and Nashville, Tenn., were colder in March only at 8, 9, and 10 kilometers. But Oakland, Calif., was warmer at all levels from the surface to 18 kilometers in March.

Since March is the seasonal opposite of September, a brief comparison of high-altitude temperatures over stations which by now have conducted radiosonde observations during both periods, is interesting. It was noted that at Nashville, Tenn., Oakland, Calif., Oklahoma City, Okla., Omaha, Nebr., Sault Ste. Marie, Mich., and Washington, D. C., temperatures during March were decidedly lower than in September 1938 at the surface, ranging from 5.7° C. colder at Oakland, Calif., to 19.8° C. less at Fargo, N. Dak. However, at these stations, with the exception of Sault Ste. Marie, Mich., the differences between March and September decreased steadily with altitude until 13 kilometers had been reached over Omaha, Nebr., and Fargo, N. Dak., and 14 kilometers at Nashville, Tenn., Oakland, Calif., Oklahoma City, Okla., and Washington, D. C. At those levels March temperatures became warmer than in September, and increased steadily with altitude until the maximum height was reached in each case. However, over Sault Ste. Marie, Mich., March was colder at all levels from the surface up to the maximum of 16 kilometers.

Mean relative humidities were moderate in most cases during March. The highest occurred over Sault Ste. Marie, Mich., and Fargo, N. Dak., at all levels, being 72 percent over the former station at 7 kilometers. Lowest humidity was located over El Paso, Tex., at all levels (32 percent at 2.5 kilometers) and over Oklahoma City, Okla. (34 percent), at 8 kilometers.

The March resultant wind directions and forces, computed for 106 stations in the United States, Canada, Mexico, Cuba, and Bermuda, are shown on charts VIII, IX, X, and XI (1.5, 3, 4, and 5 kilometers, respectively). This represents an increase of 2 stations in the United States (Birmingham, Ala., and Little Rock, Ark.), and 2 in Canada (Regina, Saskatchewan, and Toronto, Ontario). The Weather Bureau, at the close of March, was conducting regular pilot-balloon observations from 85 stations within the United States proper. A selected list of certain stations for which resultants are computed, based on 5 p. m., E. S. T., observations, is given in table 2.

There was a substantial increase in the number of observations made during the current month. Compared to February this increase was 8, 18, and 26 percent at 3, 4, and 5 kilometers, respectively, Also, it was found that 76 percent of the original observations launched at the surface (table 2) reached 2.5 kilometers over all stations, and that 71 percent of these stations continued their observations up to 5 kilometers but with only 39

percent of the original flights reaching that elevation. March resultant wind directions having southwesterly components predominated below 1.5 kilometers, but above that level winds from the northwest quadrant ranged from 53 percent of the total at 2 kilometers to 89 percent at 8 kilometers. This was due, in part, to the seasonal change over the preceding month of February when observations having northwesterly components predominated, reaching 65 percent of the total at 3 kilometers and 100 percent at 8 kilometers.

The mass movement of the air at 1.5 kilometers (chart VIII) across the northern portion of the United States and southern Canada was from the northwest quadrant during March at considerably more than one-half of the stations in the country, and from the southwest quadrant elsewhere, except for several places in southern Florida, Cuba, and Mexico. At those stations southeasterly resultant directions were noted. Comparing the 5 a. m., E. S. T., March resultant directions at certain stations with the normals computed for 1.5 kilometers, it was noted that the directions at Key West, Fla., and Houston, Tex., departed from the normal in a counterclockwise rotation by 88° and 66°, respectively. The current directions at Seattle, Wash., and San Diego, Calif., departed clockwise from normal by 22° in each case. But the resultant wind directions at Nashville, Tenn., Billings, Mont., St. Louis, Mo., Cincinnati, Ohio, Boston, Mass., and Spokane, Wash., were normal or very close to normal.

At 3 kilometers (chart IX) the a. m. resultant winds showed that at 67 percent of the stations in the United States the winds had northwesterly directions. These also occurred in southern British Columbia in all cases. But a belt across the southern portion of the United States was composed of wind directions having southwesterly components. It was noted that several places for which resultant normals have been computed showed outstanding departures. Key West, Fla., had the largest variation of any—the difference between the current month and its normal being 158°, with the March resultant rotated from normal in a counterclockwise direction. Similar conditions existed at Medford, Oreg., and Houston, Tex., respectively, where differences of 73° and 52° occurred. All but two of the stations with normals showed that current directions departed from normal by counterclockwise rotations. The directions at Fargo, N. Dak., Nashville, Tenn., Atlanta, Ga., Spokane, Wash., and Omaha, Nebr., however, remained very close to their normals during March.

Resultant wind directions for March at 4 and 5 kilometers fell within the northwest quadrant at 74 percent of all stations at both levels (charts X and XI). Although the winds at 4 and 5 kilometers are based on observations made at 5 p. m., E. S. T., a comparison with the a. m. normal resultants for certain of these stations has been made. The directions at Medford, Oreg., San Diego, Calif., Key West, Fla., and Billings, Mont., showed abnormal departures, being as much as 70°, 54°, 45°, and 7° at 4 kilometers, and 68°, 47°, 36°, and 30°, at 5 kilometers, respectively. In addition, when the p. m. resultant directions for March at all levels (table 2) were compared with the a. m. normals, it was found that San Diego, Calif., Medford, Oreg., Houston, Tex., Omaha, Nebr., Salt Lake City, Utah, Oklahoma City, Okla. Seattle, Wash., and Fargo, N. Dak., showed outstanding departures. However, at Medford, Oreg., there was an average departure of 55° at each level, and all, with the exception of 3 kilometers, departed from normal by clockwise rotations, or toward the north. Cheyenne, Wyo., had the smallest average departure for the month. The departures at 12 such stations representing most of the country, particularly the entire central portion, were clockwise with northerly tendencies, at all levels including the surface, while only two stations had departures at all levels that were counter-clockwise rotations from normal.

In this connection, too, it was found that when comparing 5 a. m. observations with those made at 5 p. m., the resultant directions at 1.5 kilometers (at 70 percent of the stations) were slightly north (when rotated clockwise) of those reported at 5 p. m. Practically the same condition prevailed at 3 kilometers, but at fewer stations. Rather wide differences between the a. m. and p. m. March resultants at 1.5 kilometers were noted at Miami, Fla. (177°—when rotated counterclockwise); San Diego, Calif. (167°—clockwise); Las Vegas, Nev. (138°—clockwise); Reno, Nev. (93°—counterclockwise); Oklahoma City, Okla. (47°—clockwise); and El Paso, Tex. (44°—clockwise). The variations at 3 kilometers were less pronounced, the greatest being at Miami, Fla. (61°—clockwise); Medford, Oreg. (39°—counterclockwise); Charleston, S. C. (30°—counterclockwise); Salt Lake City. Utah (30°—clockwise); and Boise, Idaho (29°—clockwise).

Resultant wind directions during March were more southerly than in the preceding month of February over the entire Rocky Mountain region and the Pacific coast, while east of that area, to the Mississippi Valley and between the Canadian border and Gulf coast, all directions were more northerly than in February. Elsewhere, over the eastern third of the country, the March wind directions failed to differ so definitely and uniformily from those recorded during February.

The resultant velocities for March were decidedly lower over more than 75 percent of all stations in the country at 1.5, 3, 4, and 5 kilometers than during the previous month of February. In a great many cases the current velocities were less than one-half of those recorded in the preceding month. Similar conditions existed in Canada, Mexico, and Cuba. Although current resultant velocities were much lower than in February, when they were compared to the normal velocities at certain stations, the March velocities were higher than normal at 80 percent of the stations for which normals have been computed. This was particularly noticeable in the higher levels. At a number of these stations the current velocity ranged from 3 to 13 meters per second greater than normal.

The highest resultant-wind velocities during March were found over the eastern and central portions of the United States and southern Canada at 1.5 kilometers, particularly over the middle Atlantic States and Ohio. At 3 kilometers the highest velocities spread westward to the Continental Divide, and then elsewhere over the country, except at a few Pacific coast stations at 4 and 5 kilometers. Highest velocities at all levels were located over the East and Northeast. The current resultant velocities at 1.5 kilometers were decidedly lower over 70 percent of the stations at 5 p. m., E. S. T. (table 2), than at 5 a. m., E. S. T. (chart VIII), but at 3 kilometers the opposite was true, with most of the stations having higher velocities at 5 p. m. than at 5 a. m.

Table 3 gives the maximum actual velocities recorded over the United States. The highest noted below 2.5 kilometers (42.5 meters per second) occurred over Pittsburgh, Pa., on the 6th; that between 2.5 and 5 kilometers (62.4 meters per second) was recorded over Winnemucca, Nev., on the 12th; and above 5 kilometers a velocity of 80.0 meters per second (178.9 miles per hour) was observed at Las Vegas, Nev., on the 9th at approximately 10 kil-

ometers. This is the third time a very high velocity has been recorded at Las Vegas, Nev. The previous cases occurred in February 1939 and December 1937, and the current wind speed is believed to be the highest ever recorded in March over the United States.

MEAN MONTHLY ISENTROPIC CHART

The mean monthly isentropic chart (chart XII) for March 1939, $\theta=297$, is characterized by four very pronounced moist tongues. However, except to the extreme north and east of these tongues there are no significant positive departures in precipitation. In fact, the whole southeastern part of the country is characterized by pronounced drought. However, it is to be noted that where the winds appear to be flowing upslope, the negative departures in precipitation are much smaller.

The patterns on the March mean isentropic charts for 1935, 1936, and 1937, correspond much more closely with the precipitation departures than do the March 1939 patterns.

TABLE 1.—*Mean free-air barometric pressures (P.) in mb., temperatures (T.) in °C., and relative humidities (R. H.) in percent obtained by airplanes during March 1939*

Stations and elevations in meters above sea level	Altitude (meters) m. s. l.																													
	Surface				500			1,000			1,500			2,000			2,500			3,000			4,000			5,000					
	Number of observations	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.			
Billings, Mont. (1,090 m.)	31	891	−0.7	73							847	+1.3	61	796	−1.2	61	747	−4.2	63	701	−7.5	63	616	−14.1	60	538	−21.1	56			
Cheyenne, Wyo. (1,873 m.)	33	810	−1.9	74										797	1.6	60	749	−0.3	56	703	−3.7	56	618	−11.4	56	542	−18.9	53			
Chicago, Ill. (187 m.)	30	996	0.3	76	958	0.5	73	900	−0.6	68	845	−1.0	56	794	−2.8	53	745	−4.9	52	699	−7.3	55	614	−12.8	56	538	−18.6	53			
Coco Solo, C. Z.[1] (15 m.)	31	1,012	25.1	81	958	21.5	91	904	18.3	86	852	15.8	77	804	13.5	72	757	12.3	52	713	10.1	37	631	3.9	25	559	−4.5	45			
El Paso, Tex. (1,193 m.)	31	882	9.8	35							851	12.0	33	801	9.4	34	754	6.6	32	709	3.3	34	626	−3.5	34	550	−10.3	33			
Lakehurst, N. J.[1] (39 m.)	28	1,015	1.3	76	958	0.5	71	900	−1.1	68	846	−2.5	64	793	−4.3	62	744	−6.3	60	698	−8.5	55	612	−13.9	53						
Norfolk, Va.[1] (10 m.)	22	1,020	8.6	72	962	9.2	55	905	6.7	48	851	4.6	41	800	2.8	34	752	0.4	35	706	−2.6	36	622	−8.7	33	546	−15.6	32			
Pearl Harbor, T. H.[1] (6 m.)	31	1,015	20.0	83	960	19.5	76	905	16.6	76	853	14.1	73	803	12.3	61	756	11.1	48	712	9.0	38	630	3.7	34						
Pensacola, Fla.[1] (13 m.)	21	1,021	12.7	83	963	14.0	66	908	12.0	60	855	10.7	50	805	8.1	50	757	5.7	44	712	3.6	35	629	−2.5	27	553	−8.8	31			
St. Thomas, V. I.[1 2] (8 m.)																														
Salt Lake City, Utah (1,288 m.)	31	872	2.3	76							849	5.1	62	799	2.8	59	750	−0.5	61	705	−4.2	65	620	−11.0	70	543	−16.8	60			
San Diego, Calif.[1] (10 m.)	27	1,017	10.6	85	960	10.2	82	904	9.2	72	851	7.6	63	800	5.6	56	753	3.1	51	707	0.5	48	624	−5.7	45	548	−13.2	44			
Seattle, Wash. (10 m.)	21	1,015	7.4	72	956	4.4	70	900	3.0	59	845	0.5	57	794	−2.4	53	745	−5.7	50	699	−8.9	45	613	−15.8	47						
Spokane, Wash. (597 m.)	30	947	1.2	84				901	3.1	73	847	1.0	65	796	−1.8	59	747	−5.0	59	700	−8.3	57	615	−14.9	57	538	−21.1	54			

[1] Navy.
[2] Flights discontinued temporarily.

Observations taken about 4 a. m. 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.
NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.

TABLE 1a.—*Mean free-air barometric pressures (P) in mb, temperatures (T) in °C., and relative humidities (R H) in percent obtained by radiosonde during March 1939*

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																													
	Fargo, N. Dak. (274 m.)				Nashville, Tenn. (180 m.)				Oakland, Calif. 2 (m.)				Oklahoma City, Okla. (391 m.)				Omaha, Nebr. (300 m.)				Sault Ste. Marie, Mich. (221 m.)				Washington, D.C.[1] (13 m.)					
	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.			
Surface	31	985	−8.5	88	31	997	8.2	72	31	1,019	8.4	87	31	971	7.6	69	31	982	0.9	78	31	990	−9.9	90	31	1,018	4.7	73			
500	31	957	−5.4	82	31	959	9.3	65	31	960	7.2	86	30	958	8.7	66	31	959	2.0	73	31	955	−9.3	92	31	959	2.9	68			
1,000	31	898	−5.2	74	31	903	7.6	64	31	903	7.0	73	30	903	9.3	59	31	901	2.1	66	31	895	−9.7	88	31	902	1.8	65			
1,500	31	842	−5.9	67	31	850	5.5	62	31	850	5.5	62	30	850	7.7	51	31	847	1.2	62	31	838	−10.7	83	31	848	0.3	66			
2,000	31	790	−7.3	64	31	799	3.5	59	31	799	2.9	59	31	799	5.4	47	31	795	−0.6	56	31	786	−12.3	78	31	796	−0.7	64			
2,500	31	741	−9.3	62	31	751	1.1	57	31	751	0.3	58	31	751	2.5	47	31	747	−3.1	54	31	735	−14.1	76	31	748	−2.6	63			
3,000	31	694	−11.8	61	30	706	−1.4	57	31	705	−2.8	58	31	706	−0.4	45	31	701	−5.9	53	31	688	−15.6	76	31	702	−4.9	63			
4,000	31	608	−17.6	61	30	622	−6.9	53	31	621	−8.7	55	31	622	−6.3	42	31	616	−12.1	49	30	602	−20.1	75	30	617	−9.7	61			
5,000	31	532	−23.8	59	30	546	−12.9	50	31	545	−15.3	55	31	547	−12.8	39	31	540	−18.8	46	30	526	−26.1	72	30	542	−15.4	60			
6,000	31	462	−31.0	60	30	478	−19.1	49	31	477	−21.9	50	31	479	−19.6	35	31	471	−25.6	44	29	457	−32.8	71	30	473	−21.7	59			
7,000	31	400	−38.2	58	30	418	−25.9	49	31	416	−28.9	47	31	418	−26.3	34	31	409	−33.0	43	29	395	−39.2	72	30	412	−28.5	57			
8,000	31	345	−46.2	----	29	363	−33.0	47	31	361	−36.4	45	30	363	−33.7	34	31	354	−40.2	42	28	341	−45.8	----	28	358	−35.9	55			
9,000	31	296	−52.4	----	29	314	−40.7	45	31	311	−43.7	44	30	314	−41.3	----	31	305	−47.0	----	28	293	−51.8	----	27	309	−42.9	----			
10,000	30	254	−56.6	----	29	270	−48.0	----	31	268	−50.2	----	29	270	−48.8	----	31	262	−52.9	----	27	250	−55.9	----	26	266	−48.9	----			
11,000	29	216	−59.2	----	28	232	−54.0	----	31	230	−55.1	----	26	232	−55.2	----	31	224	−57.0	----	21	214	−59.4	----	25	228	−53.9	----			
12,000	27	184	−60.3	----	27	198	−57.7	----	29	196	−57.7	----	22	198	−57.5	----	30	191	−58.6	----	19	182	−60.2	----	24	195	−57.2	----			
13,000	24	157	−59.4	----	26	169	−57.9	----	23	167	−57.6	----	20	198	−58.6	----	26	163	−57.6	----	17	155	−59.1	----	21	166	−58.0	----			
14,000	21	133	−58.6	----	26	144	−58.3	----	20	142	−57.7	----	17	144	−59.7	----	25	139	−58.0	----	14	132	−58.4	----	18	142	−58.4	----			
15,000	17	113	−58.9	----	21	123	−59.6	----	19	121	−58.9	----	13	122	−62.5	----	20	118	−60.1	----	13	113	−59.6	----	16	121	−59.4	----			
16,000	15	96	−59.4	----	18	104	−60.6	----	13	104	−60.2	----	9	104	−65.0	----	17	100	−61.6	----	8	95	−60.8	----	14	103	−61.4	----			
17,000	11	81	−59.0	----	12	89	−60.1	----	9	88	−61.0	----	6	88	−66.0	----	14	85	−61.8	----	----	----	----	----	12	88	−62.0	----			
18,000	----	----	----	----	----	----	----	----	6	76	−60.4	----	----	----	----	----	7	72	−61.6	----	----	----	----	----	11	74	−62.4	----			
19,000	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7	63	−62.2	----			

[1] Navy.
Observations taken about 4 a.m. 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.
Number of observations refers to pressure only as temperature and humidity data are missing for some observations at certain levels, also, the humidity data is not used in daily observations when the temperature is below −40° C.

TABLE 2.—*Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (E. S. T.) during March 1939*

[Directions given in degrees from North (N=360°, E=90°, S=180°, W=270°)—Velocities in meters per second (superior figures indicate number of observations)]

Altitude (meters) m. s. l.	Abilene, Tex. (537 m.)		Albuquerque, N. Mex. (1,554 m.)		Atlanta, Ga. (302 m.)		Billings, Mont. (1,095 m.)		Boise, Idaho (850 m.)		Brooklyn, N. Y. (15 m.)		Brownsville, Tex. (7 m.)		Buffalo, N. Y. (220 m.)		Burlington, Vt. (132 m.)		Charleston, S. C. (18 m.)		Cheyenne, Wyo. (1,873 m.)		Chicago, Ill. (192 m.)		Cincinnati, Ohio (157 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	204	3.9[31]	280	2.9[31]	273	2.4[27]	251	2.6[31]	309	1.1[31]	274	3.3[27]	121	4.8[30]	259	3.4[27]	299	1.0[28]	192	1.5[31]	286	3.1[28]	253	2.8[27]	250	2.2[28]
500					278	3.0[27]					280	7.0[27]	132	5.8[30]	256	6.0[27]	253	2.7[28]	208	3.9[30]			243	4.1[27]	251	4.6[29]
1,000	206	4.8[30]			256	3.8[27]			299	1.5[31]	285	9.5[24]	151	4.9[31]	251	8.9[22]	259	5.7[27]	224	5.9[29]			249	6.1[28]	251	5.7[28]
1,500	220	5.6[29]			253	6.2[28]	252	3.7[30]	285	2.0[31]	286	12.0[23]	187	2.8[23]	258	8.7[30]	264	8.2[28]	251	7.8[27]			269	8.0[33]	260	9.5[24]
2,000	240	7.3[25]	277	3.5[31]	263	8.2[23]	272	6.8[26]	282	2.8[30]	287	14.7[30]	230	3.1[26]	271	12.0[18]	285	9.7[17]	258	10.3[23]	290	4.5[29]	278	10.9[22]	276	12.6[23]
2,500	252	9.6[27]	266	4.6[31]	274	10.3[26]	274	8.5[27]	269	4.6[27]	288	19.0[17]	242	5.1[17]	281	14.3[11]			264	11.8[21]	292	7.9[25]	286	13.4[19]	278	14.8[19]
3,000	259	11.5[24]	267	6.4[29]	279	11.3[20]	281	9.5[26]	276	5.1[23]	293	25.0[16]	238	4.9[13]					274	10.2[13]	294	8.9[27]	287	16.4[17]	287	17.5[17]
4,000	262	15.3[21]	277	10.9[25]	280	15.3[17]	285	12.2[23]	287	6.0[19]			255	5.1[11]					274	14.5[13]	283	10.1[29]	290	19.0[16]	293	17.2[20]
5,000	261	18.6[19]	280	14.0[21]	281	15.8[19]	285	13.1[20]	282	5.2[26]											284	12.7[19]				
6,000	262	22.5[18]	275	17.0[19]			287	13.9[17]	305	4.2[21]											287	16.8[18]				
8,000			281	14.8[14]			286	13.1[13]																		
10,000			280	21.8[10]																						

Altitude (meters) m. s. l.	El Paso, Tex. (1,196 m.)		Fargo, N. Dak. (283 m.)		Greensboro, N. C. (271 m.)		Havre, Mont. (766 m.)		Houston, Tex. (21 m.)		Huron, S. Dak. (393 m.)		Las Vegas, Nev. (570 m.)		Little Rock, Ark. (82 m.)		Medford, Oreg. (410 m.)		Miami, Fla. (10 m.)		Minneapolis, Minn. (261 m.)		Nashville, Tenn. (194 m.)		New Orleans, La. (19 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	268	3.0[31]	346	2.2[30]	254	3.0[19]	275	1.8[28]	154	2.9[29]	321	2.6[31]	122	1.4[31]	196	0.9[16]	302	1.0[30]	115	4.0[31]	310	1.3[26]	240	1.7[29]	151	1.5[31]
500			332	3.3[30]	249	5.3[19]	253	4.6[28]	161	4.4[29]	324	2.8[31]			212	2.2[16]	302	1.2[30]	118	4.8[31]	293	2.2[26]	230	3.2[29]	179	3.3[31]
1,000			310	4.8[27]	256	6.6[28]	262	7.2[28]	174	3.9[26]	324	3.2[29]	122	1.4[31]	224	3.5[16]	269	1.0[30]	136	2.1[31]	308	3.3[28]	236	4.7[26]	215	2.0[29]
1,500	262	3.1[31]	304	7.6[23]	258	8.2[26]	277	8.2[27]	203	2.7[23]	308	4.9[27]	192	1.4[31]	259	4.6[15]	237	1.3[30]	253	0.3[30]	299	6.0[26]	257	5.0[28]	252	1.9[24]
2,000	258	4.5[31]	300	9.6[23]	264	11.2[27]	277	10.7[28]	245	3.0[30]	304	7.8[27]	238	2.5[31]	274	7.0[13]	253	1.5[29]	280	1.5[29]	281	10.0[21]	270	8.4[25]	260	4.5[29]
2,500	257	6.4[30]	296	11.7[22]	275	13.4[25]	283	10.9[21]	262	6.3[19]	293	8.9[25]	261	2.8[31]	274	9.2[13]	280	2.0[28]	279	0.9[26]	285	10.8[20]	272	10.7[24]	269	5.7[21]
3,000	258	9.3[29]	296	15.0[20]	273	14.7[19]	297	11.9[15]	270	7.7[18]	289	10.5[23]	265	3.5[30]	281	12.2[12]	243	0.3[31]	246	1.0[15]	295	12.8[19]	276	13.2[19]	276	8.0[19]
4,000	269	12.0[28]	296	16.6[17]	285	16.6[19]	276	10.9[10]	279	11.9[14]	292	12.7[20]	260	6.1[28]	287	15.1[10]	4	2.2[16]	273	2.4[17]	286	14.6[14]	282	19.6[17]	283	9.6[18]
5,000	268	14.0[19]	294	17.2[16]					283	12.2[12]	290	14.5[19]	259	8.2[28]	287	18.6[10]	5	2.4[16]	278	3.3[15]	293	15.1[10]	287	20.7[16]	296	10.8[19]
6,000	271	16.1[17]	295	20.1[14]							296	15.6[12]	260	10.0[24]			348	1.9[13]	282	5.8[13]					300	11.3[10]
8,000			284	20.4[10]							286	15.3[13]	265	13.4[20]			338	2.2[13]								
10,000											282	14.3[11]	261	21.6[18]			5	3.8[13]								
12,000											280	16.2[10]	263	22.6[14]			296	5.0[10]								
14,000													256	22.9[11]												

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)		Oklahoma City, Okla. (402 m.)		Omaha, Nebr. (306 m.)		Reno, Nev. (1,346 m.)		St. Louis, Mo. (170 m.)		Salt Lake City, Utah (1,294 m.)		San Diego, Calif. (15 m.)		San Juan, P. R. (16 m.)		Sault Ste. Marie, Mich. (198 m.)		Seattle, Wash. (14 m.)		Spokane, Wash. (603 m.)		Washington, D. C. (10 m.)		Winslow, Ariz. (1,488 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	256	4.6[31]	207	2.2[29]	278	1.3[26]	230	0.7[31]	250	2.0[29]	245	0.8[31]	278	3.9[28]	76	7.2[31]	289	2.9[28]	235	2.5[28]	210	2.1[29]	275	1.8[29]	246	3.1[31]
500	280	2.9[30]	201	2.4[29]	288	2.0[28]			236	4.6[29]			289	3.2[28]	87	9.2[31]	293	4.7[28]	226	2.5[25]			262	4.7[29]		
1,000	306	1.8[27]	207	3.4[29]	261	4.4[26]			238	6.2[27]			269	1.2[24]	94	7.7[31]	294	5.6[24]	242	2.6[31]	217	3.4[30]	270	7.2[28]		
1,500	320	2.1[28]	213	4.6[26]	261	6.0[23]	315	0.5[19]	257	8.8[25]	199	2.0[31]	145	0.4[22]	90	5.9[28]	303	6.8[21]	235	2.8[18]	239	5.0[24]	277	12.1[26]		
2,000	315	2.1[31]	247	5.3[24]	257	7.8[20]	283	1.0[19]	271	9.8[23]	197	2.6[21]	177	0.8[19]	95	4.2[20]	309	7.8[18]	238	4.1[15]	253	5.2[19]	278	14.1[24]	249	3.0[31]
2,500	324	3.7[19]	261	7.7[24]	271	9.2[20]	270	2.9[25]	283	11.7[18]	219	3.6[21]	197	1.4[17]	88	4.1[16]	305	9.5[14]	246	4.0[14]	257	5.7[16]	283	17.5[21]	251	4.0[31]
3,000	322	4.4[19]	266	10.2[24]	283	11.0[19]	260	4.3[26]	289	11.9[17]	248	4.3[21]	231	2.6[17]	106	3.7[12]	303	11.8[13]	246	3.9[12]	278	5.0[13]	283	18.7[20]	251	4.0[30]
4,000	314	6.0[18]	267	14.0[21]	283	14.0[13]	280	4.1[20]	289	15.2[13]	279	7.7[18]	242	5.4[16]			295	16.0[11]	273	4.3[10]	282	8.3[13]	289	20.6[10]	269	6.8[20]
5,000	308	7.4[16]	278	16.3[19]	284	17.1[18]	286	5.1[17]			298	8.1[13]	254	9.5[16]			296	18.8[10]			272	7.6[10]			269	10.4[20]
6,000			275	20.6[17]	284	19.8[14]	304	7.8[14]					253	12.6[14]											284	13.4[20]
8,000			280	20.5[10]			318	9.6[10]																	280	17.8[19]
10,000																									279	24.2[18]
12,000																									270	27.4[18]

TABLE 3.—*Maximum free-air wind velocities (M. P. S.), for different sections of the United States based on pilot balloon observations during March 1939*

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station
Northeast [1]	41.0	WSW	2,160	6	Pittsburgh, Pa.	50.4	NW	3,170	10	Brooklyn, N. Y.	40.0	W	8,280	2	Albany, N. Y.
East-Central [2]	42.5	WNW	2,440	7	Washington, D. C.	49.8	WSW	5,000	16	Greensboro, N. C.	52.0	WSW	5,760	16	Greensboro, N. C.
Southeast [3]	33.8	WSW	1,420	5	Spartanburg, S. C.	45.2	W	4,530	16	Atlanta, Ga.	41.2	WNW	5,320	11	Jacksonville, Fla.
North-Central [4]	36.4	WSW	2,090	15	Detroit, Mich.	44.4	NW	4,440	6	Huron, S. Dak.	48.0	WNW	8,400	6	Huron, S. Dak.
Central [5]	35.6	WSW	1,450	11	Evansville, Ind.	39.8	WSW	2,800	5	Evansville, Ind.	58.4	W	10,120	2	Wichita, Kans.
South-Central [6]	36.2	SSW	1,210	11	Fort Worth, Tex.	47.7	WSW	5,000	4	Abilene, Tex.	57.2	WSW	5,470	4	Abilene, Tex.
Northwest [7]	27.3	W	1,380	18	Havre, Mont.	39.2	SW	3,240	12	Pendleton, Oreg.	52.0	NW	6,300	16	Billings, Mont.
West-Central [8]	34.8	WNW	2,260	31	Cheyenne, Wyo.	62.4	SW	3,220	12	Winnemucca, Nev.	73.5	NNW	8,790	3	Redding, Calif.
Southwest [9]	37.5	W	2,190	4	El Paso, Tex.	42.8	W	3,810	4	El Paso, Tex.	80.0	SW	9,980	9	Las Vegas, Nev.

[1] Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.
[2] Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.
[3] South Carolina, Georgia, Florida, and Alabama.
[4] Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.
[5] Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.
[6] Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.
[7] Montana, Idaho, Washington, and Oregon.
[8] Wyoming, Colorado, Utah, northern Nevada, and northern California.
[9] Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

TABLE 4.—*Mean altitudes and temperatures of significant points identifiable as tropopauses during March 1939, classified according to the potential temperatures (10-degree intervals between 290 and 399° A.) with which they are identified. (Based on radiosonde observations.)*

Potential temperatures	Fargo, N. Dak.			Nashville, Tenn.			Oakland, Calif.			Oklahoma City, Okla.			Omaha, Nebr.			Sault Ste. Marie, Mich.			Washington, D. C.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.
290–299	6	7.7	−50.2										3	6.8	−46.0	5	6.4	−43.0			
300–309	9	8.4	−54.4				2	6.4	−31.0	1	6.4	−29.0	4	7.4	−46.2	14	7.7	−48.1	1	8.0	−42.0
310–319	13	10.1	−62.2	2	7.6	−32.0	8	9.2	−49.6	6	8.2	−38.7	15	9.2	−52.7	20	9.4	−55.6	6	9.2	−49.3
320–329	10	11.6	−68.9	14	10.2	−53.1	19	10.6	−56.1	18	10.3	−52.5	20	10.9	−60.8	10	10.6	−59.3	10	9.8	−52.0
330–339	5	12.4	−69.2	21	11.6	−59.1	13	11.7	−60.1	15	11.2	−55.5	9	11.4	−59.7	6	11.6	−60.8	14	11.6	−59.2
340–349	1	11.9	−59.0	11	11.9	−57.8	13	12.0	−56.5	8	12.0	−56.1	5	12.1	−60.0	1	12.1	−63.0	3	12.8	−64.3
350–359	1	11.6	−54.0	3	13.3	−60.7	1	12.1	−53.0	2	12.7	−58.0	2	12.2	−55.5	4	11.8	−54.2	4	12.0	−54.2
360–369				1	13.6	−61.0				4	13.6	−61.2	2	13.6	−61.0	1	11.9	−51.0	1	11.6	−53.0
370–379	2	14.2	−63.5	4	14.7	−64.0	1	15.3	−69.0	2	14.4	−63.5	2	14.6	−66.0	1	12.8	−51.0			
380–389				6	14.7	−60.6							2	15.8	−72.5	1	13.1	−50.0			
390–399				1	15.5	−61.0							4	15.1	−61.7	1	14.8	−58.0			
All (weighted means)		10.2	−61.2		11.9	−57.3		10.9	−55.5		11.0	−53.1		10.9	−57.7		9.6	−53.9		10.8	−55.1
Mean potential temperature	318.2			343.2			331.6			331.6			331.5			321.5			332.0		

RIVERS AND FLOODS

[River and Flood Division, MERRILL BERNARD in Charge]

By THOMAS S. SOUTHWICK

Precipitation was abundant during February and March, being well above normal in the central and eastern portions of the country. Floods were numerous in the eastern United States, but fortunately, the flood-producing rains were well distributed throughout this period so that these floods were, in general, characterized by long duration rather than by severity. The total damage reported from floods during February and March amounted to $1,462,535. Detailed damage figures are given in the table at the end of this article. The breaking up of ice and melting of the snow cover contributed to the floods of this period in the Northern States.

St. Lawrence drainage.—High temperatures, with attendant moderate precipitation on the 18th and 19th of February caused the ice to break up in the rivers with resulting ice jams. In the Grand River system of Michigan flood stages were reached at several points. The ice conditions at Portland, Mich., were the most severe since 1920 and gave rise to a stage of 14.0 feet, or 2 feet above flood stage. The highest previous stage was 15.2 feet in 1920. Damage was confined mostly to flooding of basements.

The Maumee River system experienced a small flood of short duration resulting from moderate precipitation on February 19 and 20. There was a snow cover in the St. Joseph River Basin which, melting under the high temperatures accompanying this rain, caused flood stages to be attained. The rise on the St. Marys River was slight, so that flood stage was not reached on the Maumee below Fort Wayne. No damage was reported.

Another rise occurred on the Maumee as the result of heavy rains on the night of March 11–12. While there was not the snow cover that contributed to the February flood, and the rains were not excessive, stages were already high, and the rivers rapidly rose above flood stage. While this flood was of minor importance, some inconvenience resulted from flooding of roads.

Atlantic Slope drainage.—Abnormally high temperatures prevailed over the eastern portion of the country during the period February 18–20. These temperatures which ranged into the 50's and 60's, together with rains of about half an inch or more falling on a snow cover of 2 to 2½ inches of water content, gave rise to rapid run-off in the rivers of the Northeastern States. In New York and in the Susquehanna watershed, where conditions were most propitious, flooding of moderate proportions took place. The ice in the northeastern rivers went out during this period of high temperatures and some ice jams resulted. Moderate damage was reported from this rise and two lives were lost when ice swept away a ramp at Elmira, N. Y.

These rivers remained at high levels so that only light to moderate rains on March 6 and 7 sufficed to raise stages to flood stage or slightly above. High temperatures on March 25 and 26 added an increment of melted snow to moderate rain, and streams in this region were generally above flood stage sometime between March 26 and 30.

The rivers of New England remained at low stages during this period. At the close of March, there remained a considerable snow mantle on the ground which constituted a potential flood hazard as the warm season approached.

In the South Atlantic States floods were prevalent throughout February and March with February having the greatest number. Rainfall along the Atlantic Seaboard ranged from one and one-half to two times that of normal during February, while March experienced about normal rainfall. This rain was the result of numerous frontal systems which invaded the Southeastern States in addition to considerable cyclonic development along the coast. Consequently, while rainfall was heavy and frequent, the areas of high intensities were generally small in area for each storm, and there are few well-defined flood periods. Most of the rivers passed flood stage several times during this period. At some stations flood stages continued for over a month, notably on the Neuse, Peedee, Santee, and Savannah Rivers where the frequent rains did not permit the rivers to recede below flood stage before the advent of another flood period. While stages were high at some stations, they were far from being excessive, although considerable damage was reported on some rivers.

East Gulf of Mexico drainage.—The rainfall distribution during February and March was similar to that prevailing in the Atlantic coast region. The precipitation for February at Meridian, Miss., was the fourth highest monthly total in 50 years of record. The Pearl, Tombigbee, and Black Warrior Rivers were at high stages from the rises of January, and the abundant rainfall in February maintained these rivers above flood stage from early in February into March for periods of over a month. While stages slightly above flood stage were reached on some of the other rivers in early February, the outstanding flood situation and highest crest stages resulted from heavy rains during the period February 25–28.

March experienced less precipitation than February, but there were locally heavy storms throughout the month, and on March 29–30 a disturbance from the Gulf resulted in heavy rainfall over the area. Several stations reported 24-hour amounts of over 3½ inches. Stages on the Tombigbee and Pearl were prolonged above flood stage into April, and on the other rivers of the region stages were rising at the close of March.

On most of the rivers in this area stages reached were moderate, causing nominal damage.

Upper Mississippi Basin.—February precipitation was about normal over the basin, but much of it was in the form of snow. The only flood stages attained in February were on the Illinois River at Peru, Ill., on the 12th due to moderate rain, and again on the Illinois at Havana and below, and on the Rock River in the latter part of the month when mild weather caused some ice breakup. In these instances flood stages were but slightly exceeded.

The Mississippi River system above La Crosse, Wis., experienced flood conditions in March which were due almost entirely to run-off from melting snow. Precipitation was decidedly below normal, but with a heavy snow cover on the ground and mild temperatures prevailing during the month, run-off was high with ice breaking up in the rivers. Moderate flood stages were reached in the latter part of the month with the crest in the main channel of the Mississippi reaching La Crosse about midnight of April 1–2. Most of the damage resulting was to highways.

In the lower drainages, the streams had receded but little from the rises due to the mild weather in February when heavy rains occurred on March 11 and 12. Storm totals of over 3 inches were reported at several stations. Moderate flood stages were general over the basin except

in the extreme northern portion in Wisconsin and Minnesota which received no precipitation during this period.

The damage was only nominal as crops had not as yet been planted. In fact, the deposit of new soil was reported to be beneficial.

Missouri Basin.—There were no floods in the Missouri Basin in February. In March, the heavy rains of the storm of March 11–12 resulted in the Grand River going above flood stage. The flooding was not extensive or damaging. On the Missouri River unusually warm weather caused much snow to melt. Considerable flooding resulted in the headwaters, and at lower levels ice gorges formed with local floods at Bismarck, N. Dak., and Nebraska City, Nebr. The stages at these latter stations were not extreme. Of the rise in the headwaters of the river, the following description is given by the official in charge, Helena, Mont.:

> Sudden melting of what remained of winter's accumulation of snow and ice on the lower levels combined with the frozen condition of the ground that prevented absorption of the snow water caused freshets and floods in northern streams and rivers during the week beginning March 18. Ice gorges were responsible for some of the flood conditions. Principal flooded areas were along the Milk and extreme lower Yellowstone Rivers, and the Big Muddy, Porcupine, and Poplar Creeks. The Milk River was reported in flood from Lohman in western Blaine County to Nashua in eastern Valley County. Numerous homes were evacuated in Malta, Chinook, Hinsdale, Saco, and in farming communities scattered throughout the flooded area.
>
> The flood waters of the Milk River and its tributaries, and other streams, washed out bridges, railroad and highway grades, and interrupted rail and highway traffic for 2 to several days.
>
> Considerable loss of livestock was reported, particularly sheep. There was much damage to farm and town buildings and related property. Flood waters of the Milk River were considered the greatest since 1917 in the affected area. In the Big Muddy section the spring run-off was reported the greatest in history.

Ohio Basin.—The outstanding flood of this period was that of the Ohio River drainage. The flood was not unduly severe, but its long duration, especially in the lower reaches throughout the wet weeks of February and March, and with memories of the great flood of 1937 still fresh in the minds of residents, it caused great apprehension. This was, however, of benefit, as people evacuated their homes, and property and stock were removed in ample time so that the damage was less in proportion to the stages reached than in most other Ohio floods.

As compared with the 1937 flood, the period of wet weather was longer, the total amounts of precipitation less and the rises in the tributaries more favorably timed. As a result, stages were not disastrously high except in the headwaters of a few of the southern tributaries of the Ohio River where new records were established.

The Ohio flood had its inception in the last 3 days of January when a general storm gave rains of about 2 inches over the entire basin, followed by another storm on February 2–3 which was centered over the upper Ohio River and the Kentucky and Cumberland headwaters. Rainfall depths varied from 2 inches over the Pittsburgh area to 4 and 5 inches over the upper Cumberland watershed. On February 3 warnings were issued for all stations on the Ohio River and most of its southern tributaries.

Rains were quite well distributed from the beginning of February until the middle of March, but there were two well-defined storm periods which resulted in two crests on much of the Ohio River. The first storm was the one of February 3–4, and the second occurred on March 4 and 5.

With the exception of the White and Wabash Rivers, serious flooding did not occur in the tributaries to the north of the Ohio River. Part of the precipitation over these northern tributaries during February was in the form of snow which served to delay the period of run-off with resulting lower crests.

The rainfall amounts at a number of stations for this flood and for the great flood of January–February 1937 are listed below:

	Dec. 26–Jan. 25 1937	Jan. 30–Mar. 15, 1939
Pittsburgh, Pa.	7.03	7.06
Parkersburg, W. Va.	9.56	10.03
Cincinnati, Ohio	15.21	10.30
Evansville, Ind.	15.42	12.64
Nashville, Tenn.	15.53	12.22
Indianapolis, Ind.	10.28	8.14

In western Pennsylvania and West Virginia there was a considerable snow cover in the mountains which contributed to the run-off from the first February storm. Considering this added increment of snow run-off, the precipitation in the headwaters of the Ohio Basin was greater than in 1937, and higher stages resulted than in 1937 on the Tygart, Youghiogheny, Monongahela, Walhonding, Little Kanawha, Elk, Guyandot, Twelve Pole Creek, Big Sandy and its tributaries, Little Sandy, and the Kentucky River down to lock No. 10. On the Cumberland River, Williamsburg, Ky., and Burnside, Ky., exceeded their 1937 crests, as did stages on the Hiwassee River at Charleston, Tenn., and on the Tennessee River at Florence, Ala., and Savannah, Tenn.

From this it can be seen that the major source of the Ohio flood was in the southern and eastern headwaters. Of the tributaries to the north, only the Scioto River at La Rue, Ohio, had a stage greater than in 1937. However, the flood stages on this river occurred in the middle of March and reached the Ohio River when its height was well below flood stage.

In addition to the general storms which covered the entire basin with generous precipitation, there were others which embraced only a portion of the area. This was especially true in the southern part of the Ohio River Basin where a number of disturbances gave heavy precipitation over the Cumberland and Tennessee River drainages. On the night of March 11–12 heavy rains up to 3 inches depth fell over the White, Wabash, and Scioto River Basins. The maximum crests of the different rises occurred after this storm.

In the lower reaches of the Ohio River, the flood was distinguished by its long duration above flood stage. A comparison at a few selected stations of the number of days above flood stage in this flood and in the 1937 flood are given:

	1939	1937
Pittsburgh, Pa.	1	10
Cincinnati, Ohio	5	19
Louisville, Ky.	7	23
Dam No. 44, Leavenworth, Ind.	15	25
Evansville, Ind.	48	41
Paducah, Ky.	47	44
Cairo, Ill.	50	50

DISTRICT REPORTS

OHIO RIVER AND TRIBUTARIES AT AND ABOVE DAM NO. 13

By W. S. BROTZMAN

Rain set in over practically the entire Pittsburgh district during the early morning of February 2, and continued until the afternoon of the 3d. The amounts of rainfall reported on the morning of the 2d were light, but by the morning of the 3d there was an average

of 1.30 inches over the upper Monongahela Basin, and an average of about 0.75 inch over the Allegheny Basin as far north as Red Bank Creek. By the afternoon of the 3d there was an additional 0.70 inch, making a total of more than 2.00 inches of rain over the Monongahela, and well over an inch over the lower Allegheny Basin. There was not much snow on the ground over the lowlands, but on the mountains of West Virginia and western Pennsylvania the ground was covered to a depth of from 6 to 10 inches. The temperature was 40 degrees or above most of the time on the 2d and 3d, over West Virginia and the southern half of western Pennsylvania, which resulted in melting a considerable portion of the snow on the ground, thereby augmenting the run-off.

All the branches of the Monongahela River and their tributaries in West Virginia, rose rather rapidly to bankful and in most cases to considerably above flood stage. At Philippi, W. Va., on the lower Tygart River, the crest stage was 24.3 feet, or 4.3 feet above the flood stage, and the Middle Fork of the Tygart River was 7.0 feet above flood stage at Midvale. All the Tygart water, however, was impounded in Tygart Dam and was not permitted to reach the Monongahela River until the Monongahela had fallen to a few feet below the tops of the lock walls.

The Monongahela River rose to 37.4 feet, or 7.4 feet above flood stage, at lock No. 7, and was in flood from there to its mouth, due to the output of the West Fork and Cheat Rivers, both of which were considerably above flood stage. The Youghiogheny River also contributed considerably to the lower Monongahela, but it was not in flood except in the vicinity of Connellsville, where it was only slightly above flood stage.

The lower Allegheny River rose about 4.0 feet, but was not a large contributing factor in raising the upper Ohio River to 25.4 feet at Pittsburgh, 0.4 foot above flood stage, at 12:30 p. m., of February 4.

A rapid drop in temperature to 20° or below set in during the night of the 3d. This rapid-freezing condition quickly checked the run-off over the basins, and, as a result, the upper Ohio River did not reach the indicated stages.

While there was considerable overflow of the streams in the upper Monongahela Basin, the overflowed land was mostly farm or pasture lands, and little damage resulted, except between locks No. 7 and 4. In the lower Monongahela and the upper Ohio Rivers the water did not reach sufficiently high stages to damage property. The estimated money value of property damaged is $20,000, most of which occured in the vicinity of Brownsville, Pa., where a part of the town was submerged.

OHIO RIVER AND SOUTHERN TRIBUTARIES FROM BELOW DAM NO. 13 TO AND INCLUDING POINT PLEASANT, W. VA.

By S. S. SCHWORM

The Ohio River was rising in the Parkersburg district at the beginning of February 1939, cresting at dam No. 14, Ohio River, on the 1st (29.5 feet) and at Parkersburg on the morning of the 2d (28.1 feet). Below Parkersburg a slow rise was still in progress on the 2d and widespread heavy rains had begun early that morning, continuing well into the night of the 3d. Flood warnings were issued for the Little Kanawha Valley and for Point Pleasant, W. Va., and Pomeroy, Ohio, on the morning of the 3d. The average rainfall for the entire storm for the State was 2.20 inches; for the Little Kanawha Valley, 2.62 inches; for the southern division of the State (which includes the entire Great Kanawha and tributary basins), 2.55 inches; and for the immediate Great Kanawha Valley (Charleston to Point Pleasant), 3.28 inches. The heavy rains in the Little Kanawha and the Great Kanawha Valley produced the only flood stages in this district: at Little Kanawha, points above Parkersburg, and at Point Pleasant and Pomeroy. The Little Kanawha at Glenville was in flood on the 3d and 4th (crest 29.7 at 5 a. m., 4th) and at Creston on the 3d to 5th (crest 25.7 at 4 a. m., 4th), while the Great Kanawha rose to flood stage at Point Pleasant on the afternoon of the 3d and backed up the Ohio River as far upstream as Pomeroy, Ohio, where the water was about 2.5 feet above the local flood stage. At Point Pleasant the crest stage of 49.1 feet was reached at 1 p. m., on the 5th. In the meantime, a crest from the upper Ohio was moving rapidly downstream, but diminishing as it progressed, so that crest stages above Pomeroy ranged from 2.4 to 8 feet below flood stages, with the nearest approach to flood stage occurring at Parkersburg and Ravenswood (dam No. 22) and the remotest at dam No. 20, Ohio River. Due to the prevailing high water in the lower portion of the district, the Ohio crest practically disappeared at some point below dam No. 22. Only moderate rains fell over the Muskingum Basin during this storm, resulting in a rise of less than 2 feet at Zanesville. In fact, this river was falling when the Ohio was nearing flood stage at the confluence.

At West Glenville the water entered several business houses and flooded probably 50 basements, with an estimated damage of $2,000. At Creston the damage was minor, probably a few hundred dollars.

At Point Pleasant about 65 families were evacuated from their riverside dwellings and many stores had water in them, but the merchants had been forewarned and had moved their stocks to second floors. No damage estimates have been received, but the amount is probably less than $10,000. At Pomeroy only minor damage was reported, probably a few hundred dollars.

OHIO RIVER AND SOUTHERN TRIBUTARIES FROM AND INCLUDING THE MOUTH OF THE KANAWHA TO AND INCLUDING THE MOUTH OF THE KENTUCKY; THE NORTHERN TRIBUTARIES OF THE OHIO FROM DAM NO. 31 TO A POINT OPPOSITE THE MOUTH OF THE KENTUCKY

By W. C. DEVEREAUX

Due to heavy rains which fell over the watershed on February 2 and 3, averaging more than 3 inches in eastern Kentucky and western West Virginia, and slightly over 4 inches in southeastern Kentucky, the southern tributaries in this region rose rather rapidly during February 3, culminating in flood conditions in most of these streams between the 3d and 8th. Record-breaking stages occurred at Wayne, W. Va.; on Twelve Pole Creek; at Paintsville, Ky., on the Levisa Fork of the Big Sandy; at Jackson, Ky., on the North Fork of the Kentucky; and in the upper Kentucky as far down as lock No. 12.

At the time when the heavy rains set in the Ohio River was moderately high and rising throughout practically its entire length. In the Cincinnati district it rose at a moderate rate during February 2 and more rapidly during the 3d, reaching flood stages on the 4th from Gallipolis Dam to Portsmouth, and in the lower portion of the district on the 5th and 6th. Crest stages were reached between February 5th and 8th and these were from 3.6 feet to 9.6 feet above flood stage. Ample warnings were issued in advance of the flood.

The damage along the Ohio River was comparatively small. On the tributaries the greatest damage occurred at Jackson, Ky., and some of the smaller towns and villages on the North Fork of the Kentucky River.

OHIO RIVER AND TRIBUTARIES FROM BELOW MOUTH OF KENTUCKY TO AND INCLUDING HAWESVILLE, KY.

By J. L. KENDALL

The flood that culminated in this district on February 9–10 had its inception in the heavy rains that fell over the Ohio River Basin on January 29–30. This period of rain was followed by another from February 2 to 4 that was more extended and produced much heavier precipitation in the upper valley. The precipitation at this time on the north side of the upper Ohio Basin was moderate and ended with considerable snow that largely remained on the ground. On the south side of the basin, especially over the drainage of the Cumberland, Tennessee, Kentucky, Licking, and Big Sandy Rivers, the rains were heavy to excessive, ranging from 2.0 to 4.0 inches on February 2–3.

The rain of this second period was not especially heavy in the Louisville district, therefore the flooding in the middle section of the river was not strongly supported by local run-off. It was built up, however, by the large discharge of the Kentucky River from February 4 to 9, due to the excessive rains over its upper basin. Moderate temperatures and light rain on the 5th and 6th caused the snow covering to melt and pass slowly into the river, without much effect in augmenting the rise.

Heavy rains on the 10th, while the river was cresting in this district and after it had commenced to fall moderately in the upper section, started another slow rise above Cincinnati, but did not entirely overcome the slow decline that was beginning in the Louisville section. Heavy rains on the 15th, mainly over the basins of the southern tributaries, stopped the fall in this district and caused a slight rise.

The Ohio River passed flood stage from Louisville to dam 45 on February 5, and at Madison on the 6th. It crested as follows: Madison, 50.2 feet, February 8; Louisville, 35.1 feet, upper gage, 62.0 feet lower gage; dam No. 43, 63.0 feet, 9th; dam No. 44, 62.5 feet; dam No. 45, 54.1 feet, 10th.

During the decline the river returned to flood stage at Madison on the 12th, and at Louisville and dam No. 43, on the 13th. At dams Nos. 44 and 45 it remained above flood stage until after the second crest had passed downstream through that part of the district on the 17th.

OHIO RIVER AND TRIBUTARIES EXCEPT THE WABASH RIVER FROM BELOW HAWESVILLE, KENTUCKY, TO AND INCLUDING DAM NO. 50 AT FORDS FERRY, KY.

By E. E. UNGER

The Ohio River flood of February-March 1939 started as a result of heavy rains over the Ohio River Valley on January 28, 29, and 30. Over the Evansville district these rains averaged well over 2.50 inches, and as a result of this rainy period, flood warnings were issued for the entire Green River Valley on January 30 and 31 for all of the Ohio River stations in this district from Newburgh, Ind., to dam No. 50 at Fords Ferry, Ky. Due to the fact that heavy rain or snow occurred over this district and the entire valley on February 2 and 3—the heaviest snowfall, 10.2 inches, of the winter at Evansville—but which melted rapidly within a few days, and since additional rains occurred generally every few days to and including February 10, it was necessary to supplement the river forecasts and warnings every few days.

In view of the fact that frequent rains occurred over the Ohio Valley from the middle of February through the middle of March, the Ohio River in this district from the mouth of the Green River to Fords Ferry, Ky., and the lower Green River were in flood continuously from the first week in February to the latter part of March. A secondary rise started March 5 due to heavy rains over the valley on the 4th and 5th. This secondary rise reached a crest averaging from 2 to 4 feet below the primary crest the middle of February.

The crest stage at Evansville was 44.81 feet on February 12 at 3 p. m. This was only the eighth time during the last 48 years that the river at this place reached a stage of 44.8 feet or more, and in this same period of time the 44.8-foot stage has been exceeded only five times.

The February-March 1939 flood passed the flood stage at Evansville about noon on February 3 and the river did not fall below the 35-foot stage again until about 9 a. m. on March 23. Thus the river was above flood continuously for 48 days, which is the greatest length of time for continuous flood stages at Evansville on record. The great flood of 1937 only lasted for 41 days.

The great duration of the February-March 1939 flood was conducive to the deposit of a large amount of silt, and it has been reported that the silt deposit after this flood is one of the heaviest of history. There is however a decided lack of fertility in this silt, indicating that it is not top soil, or very little of it.

White, Arkansas, and Red River Basins.—Many of the streams in this region were at high stages from the heavy rains at the close of January. The Black River was still above flood stage at the beginning of February. With precipitation double that of normal in February, streams remained full and rises above flood stage were frequent. Fortunately, the precipitation was well distributed so that crests were not especially high. Flood stages prevailed continuously the greater part of the period on the Black River at Black Rock, Ark., and on the White River at Georgetown, Ark., and below. Flood stages continued into April on a number of the rivers. Damage was not great as little planting had been done.

Lower Mississippi Basin.—The precipitation of this region has been described in the discussion of the floods of the eastern Gulf and the Arkansas and adjacent basins. Big Lake Outlet at Manila, Ark., went above flood stage on February 3 as a result of the heavy rains of the end of January and February 2–3 and was still above flood stage at the close of April, with slowly falling stages. On the St. Francis, there were four distinct rises, but in only three instances was flood stage passed at Fisk, Mo. Downstream, at St. Francis, Ark., these rises were merged into two distinct ones, with the interval between flood periods being but a few days. The stages were moderate and little damage resulted. The situation caused some apprehension and about 400 men were utilized to strengthen levees. One break was reported at Bertig, Ark., which caused about 1,000 acres of cultivated ground to be covered.

The Tallahatchie River passed flood stage at Swan Lake, Miss., early in February and remained above flood stage throughout February and March. A crest of 33.0 feet, or 7 feet above flood stage, was attained in the last week of February, but another rise started on March 26, and the river was rising to a new crest at the close of the month.

The Yazoo River rose steadily during the month of February, but flood stages were not reached until in March. The crest occurred at Greenwood on March 6, but had not yet been attained at Yazoo City at the close of March. Reports of damage on the Tallahatchie and Yazoo Rivers are not yet available as flood conditions were continuing at the close of the period.

On the Mississippi River, there were two distinct rises, neither of which was dangerously high but which served to keep river levels above flood stage for a long period. At Memphis and below, stages were still above flood stage at the close of March. The first rise was the result of the heavy rains of the early part of February, while the second was the crest from the February flood in the Ohio Valley, and followed the former by approximately three and a half weeks. The crest stages and dates at a few stations are given below:

Station	Flood stage	Mississippi crest and date	Ohio flood crest and date
New Madrid, Mo.	34	39.6, Feb. 25	39.8, Mar. 19–20.
Memphis, Tenn.	34	37.8, Feb. 28, Mar. 1	37.7, Mar. 23–24.
Helena, Ark.	44	47.7, Mar. 3–4	48.2, Mar. 25–27.
Natchez, Miss.	48	47.8, Mar. 10	Still rising Mar. 31.

At the close of March the first crest had not as yet reached New Orleans. The damage reported was nominal, but serious inconvenience was caused by the resulting delay in planting of cotton, and the closing of highways to traffic.

The Atchafalaya River continued throughout February and March the rise which began early in January. Flood stages were reached in March and stages were still rising at the first of April to their crests.

West Gulf of Mexico drainage.—Moderate rains at the close of February caused the Trinity and Sabine Rivers to go slightly above flood stage. Only swampy lowlands were covered and no damage resulted.

Pacific Slope drainage.—Moderate rains in the Pacific Northwest caused slight overflows on the Santiam and Willamette Rivers in Oregon on February 15 and 16. Flood stages were slightly exceeded in March on the Long Tom River and Coast Fork, tributaries of the Willamette River. These overflows were of little consequence and no damage resulted.

FLOOD DAMAGE

February–March 1939

Drainage and river	Tangible property	Matured crops	Prospective crops	Livestock and other movable property	Suspension of business	Total
ST. LAWRENCE DRAINAGE						
Grand					$11,100	$11,100
ATLANTIC SLOPE DRAINAGE						
Chenango	$125	$1,000			700	1,825
Chemung	4,000	600			5,000	9,600
Susquehanna	43,350	100		$500	900	44,850
Roanoke			$15,000		35,000	50,000
Tar	100				2,000	2,100
Neuse	2,500		8,000	200	12,000	22,700
Cape Fear	500		1,000	200	3,000	4,700
Peedee	16,500		55,000	2,000	8,000	81,500
Saluda	80					80
Broad			100			100
Congaree				100	510	610
Catawba-Wateree	300		10,000	1,000	3,800	15,100
Santee	3,500			3,000	5,000	11,500
Savannah	500			750	10,000	11,250
Ogeechee				100	2,000	2,100
Oconee, Ocmulgee, Altamaha	9,495		12,750	5,800	23,150	51,195

February–March 1939—Continued

Drainage and river	Tangible property	Matured crops	Prospective crops	Livestock and other movable property	Suspension of business	Total
EAST GULF OF MEXICO DRAINAGE						
Flint					$50	$50
Apalachicola	$2,000			$1,500	3,760	7,260
Choctawhatchee	4,050	$500		500	100	5,150
Conecuh	1,200			120	2,100	3,420
Black Warrior, Tombigbee	1,700	200		900	7,800	10,600
Pearl	1,825		$7,500	5,200	4,800	19,325
MISSISSIPPI SYSTEM						
Upper Mississippi Basin						
Mississippi above La Crosse	36,000		10,000			46,000
Rock, Iowa	2,600	200				2,800
Des Moines	9,350	790	3,940	100	2,225	16,405
Illinois	2,100					2,100
Meramec	150	200	600	65	2,000	3,015
Missouri Basin						
Big Muddy Creek	5,000					5,000
Milk River	150,000			50,000		200,000
Ohio Basin [1]						
Monongahela	17,000				3,000	20,000
Little Kanawha	2,300					2,300
East Fork of White	1,000		10,000			11,000
West Fork of White	18,000		15,000		6,000	39,000
White	6,000		9,000		1,500	16,500
Wabash	108,000	500	42,000	7,800	10,000	168,300
Cumberland [4]	155,400	14,600	20,000	10,500	111,000	311,500
Green	11,800		5,000		12,000	28,800
Ohio [2]	33,600	1,500	95,100	3,600	69,600	203,400
White Basin						
Black	1,000					1,000
White	50				2,100	2,150
Arkansas Basin						
Petit Jean	350			100		450
Red Basin						
Ouachita	2,500			1,000	13,000	16,500
Lower Mississippi Basin [3]						
Total damage, all drainages						1,462,535

[1] Damage figures are those furnished Weather Bureau in response to questionnaire and are probably incomplete. Detailed damage survey being made by U. S. Engineers.
[2] Of total Ohio River damage reported, amounts by districts are as follows: Parkersburg, $10,000; Louisville, $13,900; Evansville, $179,500.
[3] Data not available as floods still in progress.
[4] Total loss, tangible property, subsequently determined by U. S. Engineer Corps survey: $638,640.00.

Table of flood stages during February and March 1939

River and station	Flood stage	Above flood stages—dates: From—	Above flood stages—dates: To—	Crest: Stage	Crest: Date
ST. LAWRENCE DRAINAGE					
Lake Michigan					
	Feet			*Feet*	
Red Cedar: Williamston, Mich.	6	Feb. 20	Feb. 21	6.3	Feb. 20.
Grand:					
Eaton Rapids, Mich.	5	Feb. 21	Feb. 22	5.4	Feb. 22.
Portland, Mich.	12	do.	Feb. 24	14.0	Do.
Lake Erie					
St. Marys: Decatur, Ind.	13	Mar. 11	Mar. 18	20.2	Mar. 14.
St. Joseph: Fort Wayne, Ind.	12	Feb. 19	Feb. 23	14.2	Feb. 21.
		Mar. 11	Mar. 16	13.9	Mar. 13.
Maumee: Fort Wayne, Ind.	15	Feb. 19	Feb. 22	17.0	Feb. 21.
		Mar. 11	Mar. 17	18.1	Mar. 14.
Sandusky:					
Upper Sandusky, Ohio	13	Mar. 12	Mar. 14	14.3	Mar. 13.
Tiffin, Ohio	7	Mar. 14	do.	7.4	Mar. 14.
ATLANTIC SLOPE DRAINAGE					
Mohawk: Tribes Hill, N. Y.	23	Feb. 20	Feb. 20	26.5	Feb. 20.
Lackawaxen: Hawley, Pa.	6	Feb. 21	Feb. 21	7.2	Do.
Tioughnioga: Whitney Point, N. Y.	12	Feb. 20	Feb. 22	15.4	Do.
		Mar. 7	Mar. 7	12.3	Mar. 7.
		Mar. 26	Mar. 29	15.0	Mar. 27.

See footnotes at end of table.

Table of flood stages during February and March 1939—Continued

River and station	Flood stage	Above flood stages—dates: From—	Above flood stages—dates: To—	Crest: Stage	Crest: Date
ATLANTIC SLOPE DRAINAGE—continued					
	Feet			*Feet*	
Chenango:					
Sherburne, N. Y.	8	Feb. 20	Feb. 22	9.1	Feb. 20.
		Mar. 7	Mar. 7	8.3	Mar. 7.
		Mar. 26	Mar. 28	8.7	Mar. 26.
Greene, N. Y.	8	Feb. 21	Feb. 22	11.6	Feb. 21.
		Mar. 27	Mar. 29	9.3	Mar. 28.
Binghamton, N. Y.	16	Feb. 20	Feb. 22	18.7	Feb. 21.
		Mar. 27	Mar. 28	16.2	Mar. 28.
Chemung:					
Corning, N. Y.	16	Feb. 20	Feb. 21	17.8	Feb. 21.
Chemung, N. Y.	12	do.	Feb. 22	17.8	Do.
Susquehanna:					
Oneonta, N. Y.	12	do.	Feb. 23	17.1	Feb. 20, 21.
		Mar. 27	Mar. 30	13.2	Mar. 28.
Bainbridge, N. Y.	12	Feb. 20	Feb. 22	18.3	Feb. 21.
Binghamton, N. Y.	14	Feb. 21	Feb. 21	14.6	Do.
Vestal, N. Y.	12	Feb. 20	Feb. 23	21.3	Do.
		Mar. 26	Mar. 31	18.0	Mar. 28.
Towanda, Pa.	16	Feb. 20	Feb. 22	19.3	Feb. 21.
Wilkes-Barre, Pa.	22	Feb. 21	Feb. 23	24.0	Feb. 22.
Potomac: Washington, D. C. (Leiter gage).	10	Feb. 4	Feb. 6	12.6	Feb. 5.
James:					
Columbia, Va.	10	Jan. 31	Feb. 8 [1]	19.3	Feb. 1.
		Feb. 10	Feb. 19	18.5	Feb. 11.
		Mar. 1	Mar. 4	14.8	Mar. 1.
		Mar. 8	Mar. 9	10.3	Mar. 9.
Richmond, Va.	8	Feb. 2	Feb. 2	8.0	Feb. 2.
		Feb. 6	Feb. 6	8.2	Feb. 6.
		Feb. 12	Feb. 12	8.8	Feb. 12.
State Farm, Va.	11	Feb. 1	Feb. 2	13.0	Feb. 1.
		Feb. 5	Feb. 6	12.6	Feb. 6.
		Feb. 11	Feb. 12	13.1	Feb. 12.
Roanoke:					
Randolph, Va.	21	Feb. 12	Feb. 13	22.1	Do.
		do.	Feb. 15	37.1	Feb. 14.
Weldon, N. C.	31	Feb. 18	Feb. 18	31.8	Feb. 18.
		Mar. 2	Mar. 4	35.4	Mar. 3.
		Mar. 17	Mar. 17	32.3	Mar. 17.
Williamston, N. C.	10	Feb. 5	Mar. 27	11.7	Feb. 18–20.
Fishing Creek: Enfield, N. C.	14	Feb. 12	Feb. 13	14.2	Feb. 12.
Tar:					
Rocky Mount, N. C.	8	Feb. 10	Feb. 14	10.1	Feb. 12.
		Feb. 28	Mar. 5	8.7	Mar. 3.
Tarboro, N. C.	18	Feb. 12	Feb. 19	21.9	Feb. 16.
		Mar. 2	Mar. 7	20.2	Mar. 5.
Greenville, N. C.	13	Feb. 11	Feb. 24	17.2	Feb. 17.
		Feb. 28	Mar. 13	16.9	Mar. 8.
Neuse:					
Neuse, N. C.	14	Feb. 10	Feb. 18 [1]	18.4	Feb. 12, 13.
		Feb. 27	Mar. 3	15.6	Mar. 3.
		Mar. 18	Mar. 18	14.4	Mar. 18.
Smithfield, N. C.	13	Feb. 10	Feb. 20	19.5	Feb. 13.
		Feb. 27	Mar. 8	18.0	Mar. 2, 3.
Kenly, N. C.	8	do.	Mar. 5	12.3	Mar. 5.
Goldsboro, N. C.	14	Feb. 13	Mar. 14	22.0	Mar. 7.
Kinston, N. C.	14	Feb. 15	Mar. 18	18.7	Mar. 9.
Haw: Moncure, N. C.	20	Feb. 10	Feb. 10	24.4	Feb. 10.
		Mar. 1	Mar. 1	20.0	Mar. 1.
Cape Fear:					
Fayetteville, N. C.	35	Feb. 11	Feb. 13	40.1	Feb. 11.
		Feb. 28	Mar. 4	39.9	Mar. 2.
Lock No. 2, Elizabethtown, N. C.	20	Feb. 11	Feb. 20	30.2	Feb. 13.
		Feb. 27	Mar. 10	30.8	Mar. 3, 4.
Lynches: Effingham, S. C.	14	Mar. 1	Mar. 9	17.5	Mar. 4.
Waccamaw: Conway, S. C.	7	do.	Mar. 20	9.1	Mar 12, 13.
Peedee:					
Cheraw, S. C.	30	Feb. 11	Feb. 13	32.5	Feb. 11.
		Feb. 16	Feb. 17	32.7	Feb. 17.
		Feb. 27	Mar. 4	37.0	Mar. 2.
Mars Bluff Bridge, S. C.	17	Feb. 11	Mar. 19	23.8	Mar. 6.
Poston, S. C.	18	Feb. 15	Mar. 18	23.8	Mar. 8.
Black: Kingstree, S. C.	12	Mar. 2	Mar. 9	13.2	Mar. 4, 5.
Saluda:					
Pelzer, S. C.	6	Feb. 3	Feb. 8	8.0	Feb. 4.
		Feb. 10	Feb. 12	6.5	Feb. 11.
		Feb. 14	Feb. 18	7.0	Feb. 15.
		Feb. 26	Feb. 26	6.0	Feb. 26.
		Feb. 28	Mar. 5	7.5	Mar. 2.
Chappells, S. C.	13	Feb. 6	Feb. 8	13.4	Feb. 7.
		Feb. 10	Feb. 12	14.6	Feb. 11.
		Feb. 15	Feb. 18	15.7	Feb. 17.
		Feb. 26	Mar. 5	19.1	Mar. 1.
		Feb. 5	Feb. 5	14.6	Feb. 5.
		Feb. 7	Feb. 8	15.1	Feb. 8.
Broad: Blairs, S. C.	14	Feb. 10	Feb. 11	15.0	Feb. 11.
		Feb. 15	Feb. 17	16.2	Feb. 17.
		Feb. 26	Mar. 4	20.0	Mar. 1.
Congaree: Columbia, S. C.	19	Mar. 2	Mar. 2	19.9	Mar. 2.
Catawba:					
Catawba, N. C.	8	Feb. 16	Feb. 16	8.5	Feb. 16.
Catawba, S. C.	11	Feb. 26	Feb. 27	13.0	Feb. 27.
		Mar. 1	Mar. 1	15.0	Mar. 1.
		Mar. 3	Mar. 3	11.0	Mar. 3.
Wateree: Camden, S. C.	23	Feb. 17	Feb. 17	23.6	Feb. 17.
		Feb. 27	Mar. 4	29.0	Mar. 1.
		Mar. 7	Mar. 7	23.3	Mar. 7.
Santee:					
Rimini, S. C.	12	Feb. 2	Feb. 4	12.1	Feb. 2, 3.
		Feb. 5	Mar. 20	21.4	Mar. 6.
		Mar. 22	Mar. 26	12.6	Mar. 25.
		Mar. 30	[2]		
Ferguson, S. C.	12	Feb. 6	Mar. 27	15.1	Mar. 7.
		Mar. 30	[2]		

Table of flood stages during February and March 1939—Continued

River and station	Flood stage	Above flood stages—dates From—	To—	Crest Stage	Date
ATLANTIC SLOPE DRAINAGE—continued					
Savannah:	*Feet*			*Feet*	
Butler Creek, Ga.	21	Feb. 17	Feb. 17	21.6	Feb. 17.
		Feb. 27	Mar. 4	24.4	Mar. 2.
Clyo, Ga.	11	Feb. 9	Mar. 26	20.4	Mar. 7, 8.
Ogeechee:					
Midville, Ga.	6	Feb. 28	Mar. 8	8.4	Mar. 3.
Dover, Ga.	7	Feb. 27	Mar. 14	11.4	Mar. 6.
Ocmulgee:					
Macon, Ga.	18	Feb. 28	Mar. 3	21.1	Mar. 1.
Hawkinsville, Ga.	25	Mar. 3	Mar. 6	27.4	Mar. 4.
Abbeville, Ga.	11	Feb. 28	Mar. 13	16.7	Mar. 6.
Lumber City, Ga.	15	Mar. 3	do	18.3	Mar. 9.
Oconee:					
Milledgeville, Ga.	20	Feb. 27	Mar. 4	27.5	Mar. 1.
Dublin, Ga.	21	Mar. 2	Mar. 8	26.5	Mar. 4.
Altamaha:					
Charlotte, Ga.	12	Feb. 24	Feb. 24	12.0	Feb. 24.
		Feb. 27	Mar. 20	23.0	Mar. 9.
Doctortown, Ga.	10	Mar. 9	Mar. 13	10.2	Mar. 11.
Everett City, Ga.	10	Mar. 2	Mar. 23	14.1	Mar. 12, 13.
EAST GULF OF MEXICO DRAINAGE					
Chattahoochee:					
Franklin, Ga.	14	Feb. 28	Mar. 1	15.0	Feb. 28.
Eufaula, Ala.	40	Mar. 2	Mar. 3	41.8	Mar. 2.
Flint:					
Albany, Ga.	20	Mar. 1	Mar. 9	26.2	Mar. 6.
Bainbridge, Ga.	25	Mar. 4	Mar. 10	27.7	Mar. 8.
Apalachicola:					
River Junction, Fla.	20	Mar. 3	Mar. 7	22.3	Mar. 5.
Blountstown, Fla.	15	Feb. 24	Mar. 19	22.1	Mar. 6.
Choctawhatchee:					
Newton, Ala.	19	Mar. 1	Mar. 1	19.2	Mar. 1.
Geneva, Ala.	23	Mar. 3	Mar. 3	23.1	Mar. 3.
Caryville, Fla.	12	do	Mar. 7	13.0	Mar. 4.
Conecuh: Brewton, Ala.	17	Mar. 6	Mar. 6	17.1	Mar. 6.
Oostanaula: Resaca, Ga.	22	Feb. 17	Feb. 17	22.0	Feb. 17.
Etowah: Cartersville, Ga.	18	Feb. 28	Mar. 1	19.2	Mar. 1.
Coosa:					
Gadsden, Ala.	20	Mar. 1	Mar. 9	22.0	Mar. 7.
Lock No. 4, Lincoln, Ala.	17	Mar. 7	Mar. 8	17.7	Do.
Cahaba: Centerville, Ala.	23	Feb. 28	Mar. 1	26.0	Feb. 28.
		Mar. 7	Mar. 7	23.5	Mar. 7.
Alabama:					
Montgomery, Ala.	35	Mar. 2	Mar. 5	38.1	Mar. 3.
Millers Ferry, Ala.	40	do	Mar. 12	46.0	Mar. 6.
Black Warrior:					
Lock No. 10, Tuscaloosa, Ala.	46	Feb. 4	Feb. 5	49.0	eb. 5.
		Feb. 7	Feb. 7	47.7	Feb. 7.
		Feb. 12	Feb. 12	46.5	Feb. 12.
		Feb. 16	Feb. 17	47.2	Feb. 16.
		Feb. 28	Mar. 3	59.8	Mar. 1.
		Mar. 7	Mar. 7	48.7	Mar. 7.
Lock No. 7, Eutaw, Ala.	46	Mar. 3	Mar. 12	50.5	Mar. 5.
Tombigbee:					
Aberdeen, Miss.	34	Feb. 17	Feb. 21	37.0	Feb. 18.
Lock No. 4, Demopolis, Ala.	39	Feb. 6	Mar. 18	57.4	Mar. 8–10.
Lock No. 3, Ala.	33	Feb. 3	Mar. 20	57.5	Mar. 9, 10.
		Mar. 31	[3]		
Lock No. 2, Ala.	46	Feb. 8	Mar. 19	58.7	Mar. 9–12.
Gainesville, Ala.	36	do	Mar. 12	44.2	Mar. 7.
Lock No. 1, Ala.	31	Feb. 9	Mar. 22	39.6	Mar. 13–15.
Pearl:					
Edinburg, Miss.	20	Feb. 7	Feb. 13	22.0	Feb. 9.
		Feb. 15	Feb. 21	21.4	Feb. 19.
		Mar. 2	Mar. 7	21.8	Mar. 4.
Jackson, Miss.	18	Feb. 4	Mar. 18	28.9	Feb. 16.
		Mar. 30	[3]		
Monticello, Miss.	15	Feb. 9	Feb. 9	15.0	Feb. 9.
		Feb. 11	Mar. 15	20.4	Mar. 7.
		Mar. 30	[3]		
Columbia, Miss.	17	Feb. 17	Mar. 14	20.4	Mar. 5.
Pearl River, La.	12	Feb. 12	Mar. 25	15.4	Mar. 10, 11.
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Zumbro: Theilman, Minn.				12.3	Mar. 23.
Chippewa: Durand, Wis.	11	Mar. 27	Mar. 30	12.6	Mar. 28.
Black: Galesville, Wis.	10	Mar. 24	Mar. 29	12.4	Mar. 26.
Wisconsin:					
Knowlton, Wis.	12	Mar. 26	do	15.9	Mar. 27.
Portage, Wis.	17	Mar. 29	Apr. 1	18.2	Mar. 30.
Rock: Moline, Ill.	10	Feb. 21	Mar. 3	10.5	Feb. 22–25.
		Mar. 11	Mar. 18	11.3	Mar. 14, 15.
Iowa: Wapello, Iowa.	10	Mar. 13	Mar. 15	11.4	Mar. 15.
Skunk: Augusta, Iowa.	15	Mar. 12	Mar. 16	19.5	Mar. 13.
Raccoon: Van Meter, Iowa.	13	Mar. 11	Mar. 13	17.6	Mar. 12.
		Mar. 15	Mar. 16	13.0	Mar. 16.
Des Moines:					
Tracy, Iowa.	14	Mar. 12	Mar. 19	17.5	Mar. 13.
Ottumwa, Iowa.	9	Mar. 11	do	12.4	Mar. 14.

See footnotes at end of table.

Table of flood stages during February and March 1939—Continued

River and station	Flood stage	Above flood stages—dates From—	To—	Crest Stage	Date
MISSISSIPPI SYSTEM—CON.					
Upper Mississippi Basin—Continued					
Illinois:	*Feet*			*Feet*	
Morris, Ill.	13	Mar. 13	Mar. 16	15.3	Mar. 14, 15.
Peru, Ill.	17	Feb. 12	Feb. 13	17.3	Feb. 12.
		Mar. 13	Mar. 19	19.5	Mar. 15.
Peoria, Ill.	18	Mar. 16	Mar. 22	19.2	Mar. 18.
Havana, Ill.	14	Feb. 28	Mar. 6	14.1	Mar. 3.
		Mar. 12	[2]	17.9	Mar. 20.
Beardstown, Ill.	14	Feb. 27	Mar. 8	14.4	Mar. 3–5.
		Mar. 11	[3]	20.3	Mar. 20, 21.
Meramec:					
Sullivan, Mo.	11	do	Mar. 12	12.7	Mar. 11.
Valley Park, Mo.	14	Mar. 13	Mar. 14	17.0	Mar. 13.
Mississippi:					
Keokuk, Iowa.	12	Mar. 12	Mar. 17	14.0	Mar. 16.
Quincy, Ill.	14	Mar. 13	Mar. 18	17.8	Mar. 14.
Hannibal, Mo.	13	do	Mar. 20	18.0	Do.
Grafton, Ill.	18	Mar. 16	Mar. 21	19.7	Mar. 18.
Alton, Ill.	21	Mar. 17	Mar. 20	21.8	Do.
Missouri Basin					
Big Sioux: Akron, Iowa.	12	Mar. 15	Mar. 19	15.5	Mar. 17.
Floyd: James, Iowa.	14	Mar. 4	Mar. 15	16.1	Mar. 5.
Grand:					
Chillicothe, Mo.	18	Mar. 12	do	25.7	Mar. 14.
Brunswick, Mo.	12	Mar. 14	Mar. 17	13.9	Mar. 17.
Missouri:					
Bismarck, N. D.	19	Mar. 26	Mar. 29	22.2	Mar. 28.
Nebraska City, Nebr.	15	Mar. 13	Mar. 13	16.8	Mar. 13.
Ohio Basin					
Allegheny:					
Red House, N. Y.	8	Mar. 27	Mar. 28	8.6	Mar. 27.
Lock No. 8, Mosgrove, Pa.	24	Feb. 21	Feb. 21	24.2	Feb. 21.
Middle Fork of Tygart: Midvale, W. Va.	11	Feb. 3	Feb. 3	18.0	Feb. 3.
West Fork of Tygart: Clarksburg, W. Va.	5	do	Feb. 4	7.0	Feb. 4.
Buckhannon: Hall, W. Va.	10	Feb. 4	do	12.4	Do.
Tygart:					
Dailey, W. Va.	9	Feb. 3	do	13.8	Feb. 3.
Elkins, W. Va.	15	do	do	15.8	Feb. 4.
Belington, W. Va.	14	do	do	16.8	Feb. 3, 4.
Philippi, W. Va.	20	do	do	24.3	Feb. 3.
Youghiogheny: Connellsville Pa.	13	do	do	13.4	Do.
Monongahela:					
Lock No. 7, Greensboro, Pa.	30	do	do	37.4	Do.
Lock No. 4, Charleroi, Pa.	30	do	do	34.6	Feb. 4.
Walhonding: Walhonding, Ohio.	8	Jan. 31	Jan. 31	9.8	Jan. 31.
		Feb. 20	Feb. 21	8.4	Feb. 21.
		Mar. 12	Mar. 18	16.2	Mar. 13.
Tuscarawas:					
Newcomerstown, Ohio.	16	Mar. 15	Mar. 15	16.1	Mar. 15.
Coshocton, Ohio.	11	Mar. 13	Mar. 17	14.7	Mar. 14.
Little Kanawha:					
Glenville, W. Va.	23	Feb. 3	Feb. 4	29.7	Feb. 4.
Creston, W. Va.	20	do	Feb. 5	25.7	Do.
Elk: Clay, W. Va.	18	Feb. 4	Feb. 4	25.4	Do.
Guyandot: Logan, W. Va.	20	Feb. 3	Feb. 3	21.8	Feb. 3.
Twelvepole Creek: Wayne, W. Va.	25	do	Feb. 4	31.0	Feb. 4.
Levisa Fork:					
Pikeville, Ky.	35	do	do	38.9	Do.
Paintsville, Ky.	40	Feb. 4	do	42.2	Feb. 4.
Little Sandy: Grayson, Ky.	15	Jan. 30	Jan. 31	20.4	Jan. 31.
		Feb. 3	Feb. 5	26.2	Feb. 4.
Big Sandy: Lock No. 3, Louisa, Ky.	45	Feb. 4	do	47.5	Feb. 5.
Olentangy: Delaware, Ohio.	9	Mar. 12	Mar. 13	13.3	Mar. 13.
Scioto:					
LaRue, Ohio.	11	Mar. 1	Mar. 2	12.9	Mar. 1.
		Mar. 12	Mar. 14	14.9	Mar. 13.
Prospect, Ohio.	10	do	Mar. 16	13.7	Mar. 14.
Circleville, Ohio.	14	Mar. 13	Mar. 15	16.5	Do.
Chillicothe, Ohio.	16	Mar. 15	do	16.6	Mar. 15.
North Fork of Kentucky:					
Hazard, Ky.	20	Feb. 3	Feb. 3	30.0	Feb. 3.
Jackson, Ky.	28	do	Feb. 4	42.3	Feb. 4.
Kentucky:					
Lock No. 14, Heidleberg, Ky.	30	Feb. 4	Feb. 5	35.6	Do.
Lock No. 13, Ky.	38	do	do	40.0	Feb. 5.
Lock No. 10, Ford, Ky.	30	Feb. 5	Feb. 7	34.7	Feb. 6.
Lock No. 9, Ky.	20	Jan. 30	Feb. 1	21.3	Jan. 30.
		Feb. 3	Feb. 8	36.7	Feb. 6.
		Feb. 16	Feb. 18	21.6	Feb. 17.
Lock No. 7, High Bridge, Ky.	30	Feb. 6	Feb. 8	34.2	Feb. 6.
Lock No. 5, Ky.	30	Feb. 5	do	38.2	Feb. 7.
Lock No. 4, Frankfort, Ky.	31	Feb. 6	do	35.7	Do.
Barren: Bowling Green, Ky.	20	Jan. 31	Feb. 1	22.0	Jan. 31.
		Feb. 4	Feb. 7	25.8	Feb. 6.
		Feb. 12	Feb. 13	21.3	Feb. 12.
		Feb. 16	Feb. 17	21.0	Feb. 17.
		Mar. 6	Mar. 7	20.7	Mar. 7

Table of flood stages during February and March 1939—Continued

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM—contd.					
Ohio Basin—Continued					
Green:	*Feet*			*Feet*	
Munfordville, Ky	28	Jan. 31	Feb. 7	34.5	Feb. 6.
		Mar. 5	Mar. 9	31.4	Mar. 8.
Lock No. 6, Brownsville, Ky.	28	Jan. 31	Feb. 8	35.8	Feb. 5.
		Mar. 6	Mar. 9	32.9	Mar. 8.
Lock No. 4, Woodbury, Ky.	33	Jan. 30	Feb. 23	44.8	Feb. 6.
		Mar. 5	Mar. 11	40.4	Mar. 8.
		Mar. 31	(3)		
Lock No. 2, Rumsey, Ky	34	Feb. 2	Mar. 22	43.6	Feb. 20, 21.
West Fork of White:					
Anderson, Ind	10	Feb. 11	Feb. 11	10.8	Feb. 11.
		Mar. 1	Mar. 1	10.4	Mar. 1.
		Mar. 12	Mar. 13	11.5	Mar. 13.
Noblesville, Ind	14	...do...	Mar. 14	15.4	Do.
Indianapolis, Ind	12	Mar. 13	...do...	12.8	Mar. 14.
Elliston, Ind	18	Jan. 30	Feb. 6	25.0	Feb 3.
		Feb. 22	Feb. 23	18.5	Feb. 22.
		Mar. 2	Mar. 6	19.4	Mar. 3.
		Mar. 12	Mar. 19	26.6	Mar. 15.
Edwardsport, Ind	12	Jan. 31	Feb. 16	18.8	Feb. 4.
		Feb. 21	Feb. 26	16.3	Feb. 24.
		Mar. 1	Mar. 22	19.2	Mar. 17.
East Fork of White:					
Seymour, Ind	14	Mar. 12	Mar. 15	17.6	Mar. 12.
Williams, Ind	10	Mar. 14	Mar. 18	14.4	Mar. 16.
Shoals, Ind	25	Mar. 17	...do...	25.1	Mar. 17.
White:					
Petersburg, Ind	16	Feb. 1	Feb. 16	20.8	Feb. 7.
		Mar. 3	Mar. 23	23.2	Mar. 19.
Hazleton, Ind	16	Feb. 1	Feb. 17	21.3	Feb. 8.
		Mar. 3	Mar. 24	24.6	Mar. 19.
Wabash:					
Bluffton, Ind	10	Mar. 12	Mar. 16	13.8	Mar. 14.
		Feb. 3	Feb. 3	12.1	Feb. 3.
Wabash, Ind	12	Feb. 20	Feb. 22	15.3	Feb. 21.
		Mar. 1	Mar. 2	13.1	Mar. 1.
		Mar. 6	Mar. 6	12.2	Mar. 6.
		Mar. 12	Mar. 16	21.1	Mar. 13.
LaFayette, Ind	11	Feb. 11	Feb. 12	12.4	Feb. 12.
		Feb. 20	Feb. 24	17.8	Feb. 22.
		Mar. 2	Mar. 8	14.8	Mar. 3.
		Mar. 12	Mar. 18	23.3	Mar. 14.
Covington, Ind	16	Feb. 21	Feb. 25	21.3	Feb. 23.
		Mar. 2	Mar. 9	19.2	Mar. 4.
		Mar. 12	Mar. 19	27.2	Mar. 15.
Terre Haute, Ind	14	Feb. 21	Feb. 28	16.6	Feb. 26.
		Mar. 3	Mar. 22	24.8	Mar. 16.
Vincennes, Ind	14	Mar. 1	Mar. 3	14.3	Mar. 2.
		Mar. 7	Mar. 7	14.0	Mar. 7.
		Mar. 12	Mar. 25	23.7	Mar. 20.
Mt. Carmel, Ill	17	Feb. 3	Feb. 10	18.7	Feb. 8.
		Mar. 2	Mar. 26	24.7	Mar. 20, 21.
New Harmony, Ind	15	Mar. 6	Mar. 27	20.4	Mar. 22.
New: New River, Tenn	18	Feb. 3	Feb. 3	34.0	Feb. 3.
Cumberland:					
Williamsburg, Ky	19	...do...	Feb. 7	28.9	Feb. 4.
Burnside, Ky	50	Feb. 4	Feb. 5	65.0	Do.
Lock No. 21, Kentucky	48	...do...	Feb. 6	56.4	Feb. 5.
Celina, Tenn	28	Feb. 2	Feb. 20	50.1	Feb. 7.
		Mar. 1	Mar. 4	33.9	Mar. 3.
		Mar. 7	Mar. 9	32.0	Mar. 8.
Carthage, Tenn	40	Feb. 4	Feb. 12	48.0	Feb. 6.
		Feb. 16	Feb. 18	44.4	Feb. 17.
Lock No. 6	35	Feb. 3	Feb. 21	54.0	Feb. 10.
		Mar. 2	Mar. 10	39.1	Mar. 3.
Nashville, Tenn	40	Feb. 4	Feb. 22	48.7	Feb. 12.
Lock A, Neptune, Tenn	40	...do...	Feb. 23	48.0	Do.
Clarksville, Tenn	46	Feb. 5	Feb. 24	54.2	Feb. 16.
		Mar. 7	Mar. 7	46.0	Mar. 7
Lock F, Eddyville, Ky	50	Feb. 5	Mar. 16	65.1	Feb. 19, 20.
Pigeon: Newport, Tenn	6	Feb. 15	Feb. 16	10.4	Feb. 15.
		Mar. 6	Mar. 6	7.7	Mar. 6.
French Broad:					
Asheville, N. C	6	Feb. 11	Feb. 11	6.1	Feb. 11.
Oldtown, Tenn	6	Mar. 6	Mar. 7	6.5	Mar. 6.
Little Tennessee: McGhee, Tenn.	18	Feb. 16	Feb. 16	18.6	Feb. 16.
Hiwassee: Charleston, Tenn	22	...do...	...do...	22.9	Do.
Duck: Columbia, Tenn	32	Feb. 4	Feb. 5	35.4	Feb. 5.
		Feb. 16	Feb. 17	34.3	Feb. 17.
Tennessee:					
Chattanooga, Tenn	30	...do...	Feb. 18	31.7	Do.
Bridgeport, Ala	18	Feb. 4	Feb. 8	21.0	Feb. 6.
		Feb. 13	Feb. 20	23.0	Feb. 18.
		Mar. 1	Mar. 2	18.8	Mar. 2.
Widows Bar Lock, Ala.:					
Upper gage	17	Feb. 3	Feb. 22	24.6	Feb. 18.
		Mar. 1	Mar. 12	21.2	Mar. 9.
Lower gage	26	Feb. 3	Feb. 21	32.7	Feb. 18.
		Mar. 1	Mar. 11	28.9	Mar. 9.
Florence, Ala	18	Feb. 3	Feb. 25	24.9	Feb. 17.
		Feb. 28	Mar. 12	21.0	Mar. 2.
Pickwick Landing Dam, Tenn.	43	Feb. 4	Feb. 11	47.3	Feb. 8, 9.
		Feb. 15	Feb. 23	49.6	Feb.17.
		Mar. 3	Mar. 12	43.9	Mar. 11.
Savannah, Tenn	39	Feb. 5	Feb. 11	41.9	Feb. 9.
		Feb. 15	Feb. 23	44.0	Feb. 18.
Johnsonville, Tenn	31	Feb. 6	Feb. 14	34.3	Feb. 11.
		Feb. 16	Feb. 27	36.6	Feb. 20.
		Mar. 5	Mar. 13	31.1	Mar. 9, 13.

Table of flood stages during February and March 1939—Continued

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM—contd.					
Ohio Basin—Continued					
Ohio:	*Feet*			*Feet*	
Pittsburgh, Pa	25	Feb. 4	Feb. 4	25.4	Feb. 4.
Dam No. 7, Midland, Pa	30	...do...	...do...	32.6	Do.
Point Pleasant, W. Va	40	Feb. 3	Feb. 7	49.1	Feb. 5.
Gallipolis Dam, Hogsett, W. Va.	50	Feb. 4	Feb. 6	54.6	Do.
Dam No. 28, Huntington, W. Va.	50	...do...	Feb. 7	56.9	Do.
Dam No. 29, Ashland, Ky	51	...do...	Feb. 8	60.6	Do.
Dam No. 30, Greenup, Ky	52	...do...	...do...	60.1	Do.
Portsmouth, Ohio	50	...do...	...do...	57.6	Feb. 6.
Dam No. 32, near Vanceburg, Ky.	53	Feb. 5	...do...	57.7	Do.
Dam No. 33, near Maysville, Ky.	50	...do...	Feb. 9	57.1	Do.
Dam No. 35, New Richmond, Ohio.	48	...do...	Feb. 10	54.6	Feb. 7.
Dam No. 36, near Brent, Ky.	52	...do...	...do...	58.4	Do.
Cincinnati, Ohio	52	...do...	...do...	58.3	Do.
Dam No. 37, Fernbank, Ohio.	50	...do...	Feb. 11	57.3	Do.
Dam No. 38, near Grant, Ky.	51	Feb. 6	...do...	56.6	Feb. 7, 8.
Dam No. 39, Markland, Ind.	48	...do...	...do...	51.6	Feb. 8.
Louisville, Ky.:					
Upper gage	28	...do...	Feb. 13	35.1	Feb. 9.
Lower gage	55	...do...	...do...	61.9	Do.
Dam No. 43, Evans Landing, Ind.	57	...do...	...do...	62.9	Feb. 10.
Dam No. 44, Leavenworth, Ind.	53	Feb. 5	Feb. 20	62.4	Feb. 10, 11.
Dam No. 45, Addison, Ky	47	...do...	Feb. 21	54.1	Feb. 11.
Tell City, Ind	38	...do...	Feb. 23	46.2	Do.
Dam No. 46, Owensboro, Ky.	41	Mar. 6	Mar. 17	41.2	Mar. 10.
		Feb. 7	Feb. 21	45.1	Feb. 11, 12.
		Mar. 10	Mar. 10	41.0	Mar. 10.
Dam No. 47, Newburgh, Ind.	38	Feb. 4	Feb. 27	47.2	Feb. 12.
		Mar. 1	Mar. 22	44.0	Mar. 11.
Evansville, Ind	35	Feb. 4	Mar. 23	44.8	Feb. 12.
Dam No. 48, near Henderson, Ky.	38	Feb. 5	...do...	47.1	Feb. 13.
Mount Vernon, Ind	35	...do...	Mar. 25	45.2	Do.
Dam No. 49, Uniontown, Ky.	37	Feb. 6	Mar. 26	46.9	Feb. 14.
Shawneetown, Ill	33	Feb. 4	Mar. 27	47.6	Feb. 15.
Dam No. 50, Fords Ferry, Ky.	34	...do...	...do...	50.8	Do.
Dam No. 51, Golconda, Ill.	40	Feb. 7	Mar. 25	48.4	Feb. 15, 16, 20.
Paducah, Ky	39	...do...	...do...	49.1	Feb. 21, 22.
Dam No. 52, Brookport, Ill.	37	Feb. 5	Mar. 27	50.7	Feb. 22, 23.
Dam No. 53, near Mound City, Ill.	42	Feb. 6	Mar. 28	54.1	Feb. 23.
Cairo, Ill	40	Feb. 7	...do...	51.0	Mar. 17–19.
White Basin					
Current: Doniphan, Mo	10	Mar. 4	Mar. 6	11.6	Mar. 4.
Black:					
Poplar Bluff, Mo	14	Jan. 31	Feb. 1	14.5	Feb. 1.
		Mar. 5	Mar. 8	15.9	Mar. 7.
Black Rock, Ark	14	Jan. 31	Mar. 24	24.0	Do.
Little Red: Judsonia, Ark	30	Feb. 1	Feb. 2	31.0	Feb. 1.
		Feb. 27	Feb. 27	30.0	Feb. 27.
		Mar. 12	Mar. 12	31.1	Mar. 12.
White:					
Batesville, Ark	23	Feb. 21	Feb. 21	23.2	Feb. 21.
		Mar. 5	Mar. 6	24.1	Mar. 6.
Newport, Ark	26	Mar. 7	Mar. 7	26.0	Mar. 7.
Georgetown, Ark	21	Feb. 3	Mar. 26	24.8	Mar. 13.
Clarendon, Ark	26	Feb. 5	(3)	29.8	Mar. 6, 7, 15–17.
St. Charles, Ark	25	Feb. 8	(3)	28.3	Mar. 7–11.
Arkansas Basin					
Petit Jean: Danville, Ark	20	Feb. 16	Feb. 17	20.7	Feb. 16.
		Feb. 20	Mar. 2	23.8	Feb. 27.
		Mar. 6	Mar. 8	22.0	Mar. 7.
Red Basin					
Little Missouri: Boughton, Ark.	20	Feb. 4	Feb. 5	20.6	Feb. 4.
		Feb. 27	Feb. 27	21.0	Feb. 27.
Saline: Benton, Ark	20	Feb. 3	Feb. 3	24.0	Feb. 3.
Ouachita:					
Arkadelphia, Ark	17	...do...	Feb. 4	21.4	Do.
		Feb. 21	Feb. 21	17.0	Feb. 21.
		Feb. 26	Feb. 28	17.9	Feb. 26.
Camden, Ark	26	Feb. 4	Mar. 9	34.6	Mar. 3.
		Mar. 31	(3)		
Monroe, La	40	Mar. 4	Mar. 23	41.3	Mar. 12–15.
Black: Jonesville, La	50	Mar. 16	Mar. 22	50.0	Mar. 16–22.
		Mar. 26	(3)		
Little: Whitecliffs, Ark	25	Feb. 27	Mar. 3	26.0	Feb. 28.
Sulphur:		Feb. 15	Feb. 18	22.9	Feb. 15.
Ringo Crossing, Tex	20	Feb. 20	Feb. 23	23.8	Feb. 20.
		Feb. 25	Feb. 28	23.0	Feb. 26.
		Mar. 26	(3)	24.4	Mar. 27.
Naples, Tex	22	Feb. 19	Mar. 5	26.8	Mar. 2.
		Mar. 29	(3)		
Cypress: Jefferson, Tex	18	Mar. 3	Mar. 5	18.3	Mar. 4.

See footnotes at end of table.

Table of flood stages during February and March 1939—Continued

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM—contd.					
Lower Mississippi Basin					
	Feet			*Feet*	
Big Lake Outlet: Manila, Ark.	10	Feb. 3	(1)	16.6	Mar. 10-12.
St. Francis:		Jan. 31	Feb. 4	23.4	Feb. 2.
Fisk, Mo.	20	Feb. 22	Feb. 23	20.8	Feb. 22.
		Mar. 1	Mar. 16	24.3	Mar. 8.
St. Francis, Ark.	18	Feb. 3	Feb. 21	21.3	Feb. 6.
		Feb. 25	Mar. 23	22.4	Mar. 11.
Tallahatchie: Swan Lake, Miss.	26	Feb. 4	(1)	33.0	Feb. 22, 23.
Yazoo:					
Greenwood, Miss.	35	Mar. 1	Mar. 12	35.5	Mar. 6.
Yazoo City, Miss.	29	Mar. 5	(1)	-------	
Mississippi:					
New Madrid, Mo.	34	Feb. 11	Mar. 28	39.8	Mar. 19, 20.
Memphis, Tenn.	34	Feb. 18	(1)	37.8	Feb. 28, Mar. 1.
Helena, Ark.	44	Feb. 20	(1)	48.2	Mar. 25-27.
Greenville, Miss.	36	Feb. 28	(1)	38.5	Mar. 30.
Natchez, Miss.	48	Mar. 26	(1)	-------	
Baton Rouge, La.	35	Mar. 3	(1)	-------	
Angola, La.	45	Mar. 5	(1)	-------	
Donaldsonville, La.	28	Mar. 6	(1)	-------	
Reserve, La.	22	Mar. 12	(1)	-------	
New Orleans, La.	17	Mar. 29	(1)	-------	

Table of flood stages during February and March 1939—Continued

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM—contd.					
Atchafalaya Basin					
Atchafalaya:	*Feet*			*Feet*	
Simmesport, La.	41	Mar. 28	(1)	-------	
Melville, La.	37	Mar. 7	(1)	-------	
Atchafalaya, La.	25	Mar. 21	(1)	-------	
WEST GULF OF MEXICO DRAINAGE					
Sabine: Logansport, La.	25	Mar. 1	Mar. 6	26.0	Mar. 3, 4.
Trinity: Liberty, Tex.	24	Feb. 28	Mar. 3	24.9	Mar. 1.
PACIFIC SLOPE DRAINAGE					
Columbia Basin					
Santiam: Jefferson, Oreg.	10	Feb. 15	Feb. 15	11.1	Feb. 15.
Coast Fork: Saginaw, Oreg.	9	Mar. 12	Mar. 12	9.6	Mar. 12.
Long Tom: Monroe, Oreg.	12	Mar. 7	Mar. 9	12.2	Mar. 8, 9.
Willamette: Harrisburg, Oreg.	10	Feb. 15	Feb. 16	11.8	Feb. 16.
		Mar. 13	Mar. 13	10.6	Mar. 13.

[1] Went slightly below flood stage on Feb. 3.
[2] Went slightly below flood stage on Feb. 16.
[3] Continued into April.

WEATHER ON THE ATLANTIC AND PACIFIC OCEANS

[The Marine Division, I. R. TANNEHILL in charge]

NORTH ATLANTIC OCEAN, MARCH 1939

By J. H. GALLENNE

Atmospheric pressure.—The entire North Atlantic, with the exception of the extreme northwest portion, experienced slightly higher pressure averages than normal. The greatest positive departures were shown at Valencia, Ireland, and Lerwick, Shetland Islands, with readings of +0.22 inch and +0.18 inch, respectively; while −0.02 inch was noted at Belle Isle, Newfoundland, and −0.17 inch was recorded at Julianehaab, Greenland.

Extreme pressure readings from vessel reports at hand were 30.89 inches and 28.16 inches. The first was received from an unidentified ship at about 150 miles southwest of Valencia during the evening of March 15; while the latter was reported from the American steamship *American Importer*, when near 54°40′ N. and 26°10′ W., at 7 a. m. of March 1.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, March 1939*

Station	Average pressure	Departure	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Julianehaab, Greenland	29.50	−0.17	30.22	19	28.74	8
Reykjavik, Iceland	29.68	.00	30.51	28	28.79	21
Lerwick, Shetland Islands	29.88	+.18	30.51	28	29.12	22
Valencia, Ireland	30.12	+.22	30.77	13	29.26	2
Lisbon, Portugal	30.11	+.11	30.48	5	29.53	29
Madeira	30.04	+.03	30.33	5	29.68	3
Horta, Azores	30.19	+.01	30.58	22	29.62	1
Belle Isle, Newfoundland	29.81	−.02	30.52	21	28.88	2
Halifax, Nova Scotia	30.02	+.06	30.46	20	29.26	14
Nantucket	30.03	+.05	30.52	8	29.10	13
Hatteras	30.10	+.06	30.54	19	29.43	13
Bermuda	30.17	+.03	30.38	9	29.84	3
Turks Island	30.07	+.05	30.17	7	29.95	21
Key West	30.08	+.03	30.25	23	29.90	13
New Orleans	30.11	+.07	30.53	19	29.79	26

NOTE.—All data based on a. m. observations only, with departures compiled from best available normals related to time of observation, except Hatteras, Key West, Nantucket, and New Orleans, which are 24-hour corrected means.

Cyclones and gales.—The first week of the month saw stormy weather in higher latitudes over the ocean, due to a successions of LOWS which moved from continental North America causing barometric pressure readings well below 29.00 inches during this entire period.

The American steamship *Wacosta* reported a fresh gale on the evening of the 2d, increasing to force 11 with very high sea, when near 50° N. and 16½° W. A whole gale accompanied by very high confused sea was reported from the steamship *Black Condor*, giving her position as about 5° east of the *Wacosta*.

From the 8th to the 14th, storm conditions continued to dominate the upper portions of the Atlantic. Reports of fresh gales to storm force winds were received from ships at sea, as shown in the table of gales.

At 7:30 p. m. of March 12, a depression (29.42 inches) was central near Norfolk, Va., and at 10 p. m. the American steamship *Iowan* near 36° N., and 74° W., bound from New York to Cristobal, reported overcast weather with fog banks, wind shifting around the compass to southwest, barometer dropping, rough sea, and long southwest swell.

On the 13th and 14th, this barometric depression spread over the coastal ocean area from Hatteras to Maine. Several vessels reported encountering gales of force 8–10. During the evening of the 13th, the French steamship *Ile de France* reported a pressure reading of 28.94 inches, and on the next morning several vessels reported even lower readings near the center of the disturbance. Charts XIII and XIV present the situation on these days.

A strong anticyclone prevailed over the ocean in the vicinity of Valencia from March 11 until the 16th, during which time the atmospheric pressure readings ranged from 30.50 inches to 30.70 inches or more.

From the 16th until the close of the month only a few reports of scattered gales of force 8 to 9 have been received and indications are that no abnormal storminess existed.

Fog.—Reports at hand indicate practically all fog encountered by vessels during the month, lay over the western portion of the Atlantic, with but three instances being reported east of the thirtieth meridian. Fog was decidedly more frequent during the first half of the month than during the latter half. Portions of the coast area between Hatteras and Halifax experienced foggy weather from the 4th to the 12th. In the extreme northern Gulf of Mexico, fog was reported on 7 days during the month, all occurring between the 1st and the 12th. According to reports at hand, the two 5° squares, 40° to 45° N., 50° to 55° W. and 35° to 40° N., 70° to 75° W. (with six occurrences) had more fog than any other part of the North Atlantic.

OCEAN GALES AND STORMS, MARCH 1939

Vessel	Voyage		Position at time of lowest barometer		Gale began March	Time of lowest barometer, March	Gale ended March	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Direction and highest force of wind	Shifts of wind near time of lowest barometer.
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				*Inches*					
Beemsterdyk, Du. S. S.	Antwerp	New Orleans	45 37 N.	17 15 W.	1	11a, 1	1		WSW.	SW, 9	WSW.	W, 9	SW-NNW.
American Importer, Am. S. S.	Belfast	Boston	54 40 N.	26 10 W.	1	7a, 1	2	28.16	WNW.	WNW, 9	W	NW, 9	S-WNW.
Scanyork, Am. S. S.	Copenhagen	New York	56 12 N.	28 06 W.	[1] 28	6a, 1	2	28.64	NE.	N, 9	WNW.	NNW, 9	NE-NNW.
American Merchant, Am. S. S.	London	Boston	48 00 N.	33 36 W.	2	10p, 2	4	28.88	W	W, 8	W	W, 9	
Beemsterdyk, Du. S. S.	Antwerp	New Orleans	42 36 N.	24 34 W.	3	4a, 3	4		SW.	SW, 9	SSW.	W, 9	SW-WSW.
Nordbo, Dan. M. S.	do	Boston	41 18 N.	21 24 W.	2	6a, 3	4	29.24	SW.	WSW, 8	WSW.	WSW, 9	
Jamaica Planter, Br. M. V.	Port Antonio	Rotterdam	47 34 N.	22 30 W.	2	4a, 3	3	28.77	S	SSE, 9	SSE	SSE, 9	SSE-SW.
Black Condor, Am. S. S.	Antwerp	New York	49 28 N.	21 36 W.	2	8a, 3	4	28.82	SSW.	SW, 8	W	S, 10	S-WSW.
Wacosta, Am. S. S.	Mobile	Newcastle	49 45 N.	16 24 W.	2	Noon, 3	4	28.98	S	SSW, 10	SW	SSW, 11	SSW-SW.
American Trader, Am. S. S.	New York	London	41 20 N.	57 30 W.	5	3a, 6	6	29.49	SSW.	WNW, 5	WNW.	S, 11	S-WNW-W.
Svanhild, Dan S. S.	do	Oslo	43 00 N.	61 48 W.	7	4a, 7	9	29.28	WSW.	WSW, 6	W	W, 9	WSW-W.
Bilderdijk, Du. S. S.	Rotterdam	Boston	45 18 N.	50 54 W.	7	9a, 7	9	29.07	W	SW, 5	WNW.	W, 9	
Black Condor, Am. S. S.	Antwerp	New York	46 36 N.	42 55 W.	6	7p, 7	10	29.54	SSE.	S, 8	W	W, 10	S-SW.
Scanmail, Am. S. S.	Copenhagen	Baltimore	58 06 N.	11 50 W.	7	4a, 8	8	29.61	W	W, 8	NW	WNW, 9	W-WNW.
Pres. Harding, Am. S. S.	Cobh	New York	46 30 N.	44 00 W.	7	4p, 8	9	29.51	S	WSW, 8	W	W, 10	WSW-W.
Exeter, Am. S. S.	Gibraltar	Boston	43 30 N.	39 48 W.	8	10p, 8	9	29.83	SW	W, 7	W	W, 10	SW-W.
American Farmer, Am. S. S.	London	New York	47 — N.	38 — W.	8	6p, 8	9	29.38	WSW.	SSE, 6	W	W, 8	SSE-W.
Black Hawk, Am. S. S.	Rotterdam	do	50 16 N.	29 55 W.	9	4a, 9	10	29.62	S	S, 8	W	W, 9	None.
Black Condor, Am. S. S.	Antwerp	do	[2] 43 32 N.	50 34 W.	10	3p, 10	11	29.29	SE.	SSW, 8	NNW.	SSE, 9	SSE-WNW.
Nordbo, Dan. M. S.	do	Boston	41 30 N.	51 06 W.	10	2p, 10	10	29.47	SSW.	SW, 10	NW	SW, 10	
Steel Scientist, Am. S. S.	Port Said	do	38 09 N.	57 50 W.	10	Noon, 10	11	29.69	SSW.	W, 9	N	WSW, 10	W-WNW.
Black Heron, Am. S. S.	New York	Antwerp	41 46 N.	54 13 W.	10	10a, 10	11	29.36	E	SW, 8	NNW.	W, 9	
Svanhild, Dan. S. S.	do	Oslo	50 54 N.	44 00 W.	10	4a, 11	11	28.93	ESE.	S, 7	W	SE, 10	SE-W.
Scanmail, Am. S. S.	Copenhagen	Baltimore	54 24 N.	31 30 W.	11	9p, 11	11	29.61	S	S, 9	SW	S, 10	S-SW.
Ile de France, Fr. S. S.	Plymouth	New York	47 11 N.	35 15 W.	11	5p, 11	11	29.80	SSE.	S, 9	SW	S, 9	SSE-SW.
Black Hawk, Am. S. S.	Rotterdam	do	47 27 N.	38 03 W.	11	Noon, 11	11	29.74	SSE.	SSE, 9	W	SSE, 9	
Iowan, Am. S. S.	New York	Cristobal	36 12 N.	74 12 W.	12	10p, 12	12	29.44	SW.	SSW, 9	SW	SSW, 9	SSW-W.
Vincent, Am. S. S.	Dundee	Boston	55 28 N.	27 38 W.	10	4a, 12	12	29.84	WSW.	SW, 9	W	SW, 9	SW-W.
Ile de France, Fr. S. S.	Plymouth	New York	44 29 N.	43 31 W.	12	3p, 12	12	29.17	ENE.	NW, 9	NW	NW, 9	SE-NW.
Black Hawk, Am. S. S.	Rotterdam	do	45 50 N.	45 46 W.	12	4p, 12	13	29.15	NNE.	NNE, 6	NW	NNW, 10	
West Cusseta, Am. M. S.	Gothenburg	do	[3] 45 49 N.	46 01 W.	12	4p, 12	13	29.25	N	N, 8	NW	NW, 9	NE-NW.
Black Condor, Am. S. S.	Antwerp	do	41 08 N.	67 02 W.	13	4p, 13	14	28.88	WSW.	W, 8	NW	N, 11	SSW-W.
Winamac, Br. S. S.	Amsterdam	Aruba	38 18 N.	31 46 W.	12	Noon, 13	13	29.77	SE.		WSW.	SE, 9	SE-WSW.
Eglantine, Am. S. S.	New Orleans	Liverpool	43 28 N.	32 43 W.	12	2p, 13	13	29.70	SSE.	SSE, 9	W	SSE, 9	SSE-W.
Nordbo, Dan. M. V.	Antwerp	Boston	42 18 N.	64 36 W.	13	7p, 13	14	28.81	E	E, 10	N	NNE, 10	
California, Am. T. S.	Antarctic Ocean.	New York	37 06 N.	70 06 W.	13	9a, 13	13	29.30	W	W, 7	NW	NW, 8	W-NW.
Standard Arrow, Am. T. S.	Beaumont	Paulsboro	36 50 N.	75 15 W.	13	1a, 13	13	29.44	NW.	SW, 2	NW	NW, 8	SW-NW.
Black Heron, Am S. S.	New York	Antwerp	46 55 N.	34 56 W.	13	10a, 13	14	29.63	SSE.	SSE, 9	SW	SE, 10	
Ile de France, Fr. S. S.	Plymouth	New York	41 34 N.	62 40 W.	13	1a, 14	14	28.70	E	SW, 11	NW	SW, 11	SW-NW.
West Cusseta, Am. M. S.	Gothenburg	do	[3] 43 34 N.	56 44 W.	14	2p, 14	15	28.82	N	SE, 4	NW	NW, 9	ESE-NE.
Casanare, Br. S. S.	Kingston	Liverpool	41 00 N.	48 00 W.	13	8a, 14	14		SE.	SE, 7	SE	SE, 8	
Antinous, Am. S. S.	St. John, N. B.	London	44 55 N.	43 00 W.	14	4p, 14	15	29.59	SE.	SSE, 9	S	SSE, 9	SSE-S.
Black Hawk, Am. S. S.	Rotterdam	New York	43 09 N.	57 36 W.	14	Noon, 14	15	28.82	NW.	SE, 3	NNW.	NNW, 10	
Antinous, Am. S. S.	St. John, N. B.	London	47 54 N.	32 02 W.	16	Noon, 16	16	29.82	S	S, 8	S	S, 8	
Salabangka, Du. S. S.	Dakar	Boston	34 27 N.	58 55 W.	23	5a, 23	24	28.67	WNW.	WNW, 8	NW	WNW, 9	W-WNW.
Black Heron, Am. S. S.	Rotterdam	New York	45 44 N.	42 37 W.	29	Noon, 29	30	29.56	SW.	SW, 8	NNW.	NNW, 8	
Sarcoxie, Am. S. S.	Dundee	do	52 00 N.	34 50 W.	30	6p, 30	31	28.76	SE.	SSW, 10	W	W, 12	SW-W.
Veendam, Du. S. S.	Southampton	Halifax	47 18 N.	36 22 W.	30	7a, 30	31		W	WSW, 6	WNW.	WNW, 9	
American Merchant, Am. S. S.	London	New York	48 29 N.	33 12 W.	30	Noon, 30	31	29.33	WSW.	WSW, 8	W	W, 9	
NORTH PACIFIC OCEAN													
Maunawili, Am. S. S.	Honolulu	San Francisco	24 30 N.	153 50 W.	1	4p, 2	2	30.04	SE.	ESE, 8	ESE	ESE, 8	None.
Bengalen, Du. M. S.	Manila	Portland, Oreg.	28 02 N.	148 45 E.	2	10p, 2	3	29.60	SE.	SSW, 7	W	WSW, 8	SSE-WSW.
Empress of Japan, Br. S. S.	Honolulu	Yokohama	32 21 N.	147 34 E.	2	6a, 3	3	29.44	SE.	NW, 7	N	NNW, 10	SSW-NNW.
Hoyo Maru, Jap. M. S.	El Segundo	Tokuyama	33 54 N.	157 05 E.	3	6p, 3	4	29.37	SSE.	SW, 5	N	S, 9	SSW-W.
Toorak, Br. S. S.	Hondagua, P. I.	Los Angeles	34 10 N.	163 19 E.	2	4a, 4	5	29.27	E	SW, 4	W	SE, 10	S-SW.
Bonnington Court, Br. M. S.	Los Angeles	Yokohama	31 56 N.	166 02 E.	3	3a, 4	5	29.80	ESE.	S, 10	NW	S, 10	S-SW.
Nankai Maru, Jap. M. S.	Yokohama	Los Angeles	[3] 44 24 N.	166 22 E.	4	Mdt, 4	4	28.80		SE, 6		ENE, 8	
Baranof, Am. S. S.	Valdez	Sitka	59 18 N.	141 42 W.	4	3a, 5	4	29.34	ENE.	E, 6	ENE.	ENE, 8	ENE-E.
Atutasan Maru, Jap. M. S.	Yokohama	San Francisco	46 25 N.	171 03 E.	4	3a, 5	6	28.93	ENE.	SSE, 7	WSW.	E, 9	SE-WSW.
Olopana, Am. S. S.	Portland, Oreg.	Honolulu	41 12 N.	134 12 W.	6	3a, 7	8	29.86	WSW.	WSW, 7	NNW.	NNW, 9	WSW-WNW.
Bonnington Court, Br. M. S.	Los Angeles	Yokohama	33 27 N.	149 32 E.	7	3a, 8	9	29.72	SE.	SSE, 8	NW	SSE, 8	SSE-WSW.
Manoa, Am. S. S.	San Francisco	Honolulu	35 44 N.	129 55 W.	8	8p, 8	9	29.74	W	W, 6	NW	WNW, 9	W-WNW.
Mauna Ala, Am. S. S.	Honolulu	San Francisco	32 42 N.	135 36 W.	9	3a, 9	9	30.16	N	NNW, 6	N	N, 8	NW-N.
President Pierce, Am. S. S.	do	Yokohama	[3] 34 47 N.	156 44 E.	9	4a, 9	10	29.62	WNW.	SW, 5	NNW	WNW, 9	SSW-WSW.
Talthybius, Br. S. S.	Yokohama	Seattle	40 42 N.	150 38 E.	9	4a, 10	10	29.64	WNW.	NW, 8	NNW.	NW, 8	
Swiftsure Bank LV No. 113.	On station		48 30 N.	125 00 W.	10	Noon, 10	10	29.59	SE.	SE, 10	SW	SE, 10	SE-SW.
Detroit, U. S. S.[4]	Culebra	San Diego	10 30 N.	89 42 W.	10	6a, 10	10	29.79				NNE, 8	
Bronxville, Nor. M. S.	Blaboa	Yokohama	33 25 N.	143 20 E.	11	4p, 12	13	29.63	S	WSW	N	WNW, 8	S-SW-N.
Grete Maersk, Dan. M. S.	Yokohama	Los Angeles	40 58 N.	155 38 E.	12	Noon, 13	13	29.25	S	SSW, 6	SSW	S, 8	S-SSW.
Yamazuki Maru, Jap. M. S.	do	San Francisco	44 12 N.	162 18 E.	12	Noon, 14	14	29.30	SE.	SE, 8	SE	SE, 9	SE-SW.
Grete Maersk, Dan. M. S.	do	Los Angeles	43 24 N.	163 28 E.	14	1p, 14	14	29.20	SSE.	SSE, 9	W	W, 10	SSE-W.
Washingtonian, Am. S. S.	Balboa	San Diego	15 48 N.	94 00 W.	19	6p, 19	20	29.86	NW.	N, 8	NE	N, 8	NW-NE.
Steel Seafarer, Am. S. S.	East coast, United States.	Far East	11 45 N.	96 10 W.	22	4a, 22	22	29.89	N	NNE, 4	NE	NE, 8	None.
Amagisan Maru, Jap. M. S.	Yokohama	San Francisco	46 30 N.	176 18 E.	22	6a, 23	23	29.00	ESE.	E, 8	ESE	E, 8	
Hoegh Silverlight, Nor. M. S.	Cebu	Los Angeles	38 24 N.	176 43 E.	23	Mdt, 24	25	29.03	NNW.	SSW	S	WNW, 9	
Sangstad, Nor. M. S.	Manila	San Pedro	[3] 34 00 N.	152 00 E.	23	4p, 23	24	29.29	S	W, 8	NW	WNW, 12	Do.
Admiral Halstead, Am. S. S.	Legaspi, P. I.	San Francisco	30 53 N.	152 41 E.	24	4a, 24	24	29.58	WNW.	WNW, 8	NW	W, 9	Do.
Daini Ogura Maru, Jap. M. S.	Yokohama	Los Angeles	[3] 39 00 N.	167 00 W.	24	2a, 25	25	29.20	SSE.		W	SSE, 9	
Sangstad, Nor. M. S.	Manila	San Pedro	[3] 33 37 N.	161 25 E.	26	5p, 26	28	29.19	SW.	SW, 12	W	SW, 12	SW-WNW-W.
Empress of Japan, Br. S. S.	Yokohama	Honolulu	32 52 N.	168 42 E.	26	2a, 27	27	29.36	SW.	SSW, 10	WSW.	SSW, 10	SW-SSW.
Naruto Maru, Jap. M. S.	do	Los Angeles	43 15 N.	163 00 E.	30	4a, 31	31	29.85	SSE.	SE, 7	ESE	SE, 8	

[1] February.
[2] Position approximate.
[3] Data from 6 a. m. observation only.

NORTH PACIFIC OCEAN, MARCH 1939

By WILLIS E. HURD

Atmospheric pressure.—Over the central and eastern Aleutian region, pressures averaged high for the month in 1939, the means for Dutch Harbor, 29.95 inches, and for St. Paul in the Bering Sea, 29.99, being about 0.25 inch above the normal. The daily pressure range at these stations was unusually great, with extremes at St. Paul of 30.62 inches on the 31st and 28.32 inches on the 27th. The Aleutian LOW, as an average for the month, had two centers, one over the western part of the Gulf of Alaska (Kodiak, 29.72); the other over extreme northwestern Pacific waters (Petropavlosk, 29.71). The lowest barometer readings of the month, 28.11 to 28.19 inches, were reported by ships along the northern routes southwest of the Aleutian Islands from the 23d to the 26th.

The center of the North Pacific anticyclone was situated on the average a short distance west of the California coast. The anticyclone off the China coast showed the usual spring decrease in strength.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, North Pacific Ocean, March 1939, at selected stations*

Stations	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Point Barrow	30.30	+0.15	30.88	12	29.72	20
Dutch Harbor	29.95	+.25	30.74	31	28.58	27
St. Paul	29.99	+.26	30.62	31	28.32	27
Kodiak	29.72	+.03	30.42	31	29.00	4
Juneau	29.92	−.02	30.51	16	28.91	19
Tatoosh Island	30.06	+.10	30.45	16	29.55	13
San Francisco	30.10	+.04	30.41	1	29.79	9
Mazatlan	29.90	−.02	29.98	18	29.84	10, 27
Honolulu	30.01	−.03	30.19	28	29.83	20
Midway Island	30.02	−.05	30.30	30	29.65	24
Guam	29.86	−.04	29.94	27, 29, 30	29.80	6, 7, 10
Manila	29.87	+.01	29.97	26	29.83	7, 8
Hong Kong	29.92	−.06	30.07	17	29.78	10
Naha	29.99	−.01	30.15	19	29.77	10
Titijima	29.98	−.02	30.18	9	29.74	22
Petropavlosk	29.71	−.03	30.21	16	29.24	6

NOTE.—Data based on 1 daily observation only, except those for Juneau, Tatoosh Island, San Francisco, and Honolulu, which are based on 2 observations. Departures are computed from best available normals related to time of observation.

Cyclones and gales of the extratropics.—As in the preceding February, the gale-producing cyclones of March were largely confined to the western waters of the North Pacific. East of the 175th meridian of east longitude, gales were few in number and for the most part localized. The stormiest region on the ocean is shown by reports to have been that lying between latitudes 30° and 35° N., longitudes 145° and 170° E., where gales were most frequent and, on the 24th and 26th, of greatest force, being of hurricane strength for short periods. A secondary region of storminess lay to the northward along the routes between the western Aleutians and the 150th meridian to the eastward of northern Japan. The upper steamship routes on the eastern half of the ocean were singularly free of high winds, with only one gale in excess of force 7 reported in open sea to the northward of the 40th parallel.

Cyclonic disturbances were frequent on western waters. The majority were of the type peculiar to the Aleutian LOW, usually with centers in middle and high latitudes, but often with their southern quadrants extended almost into the Tropics. These disturbances for the most part had no decided forward movement. The cyclone of the 1st to 8th, however, can be traced from a position near the east coast of China east-northeastward to about 35° N., 160° E., on the 3d, and thence generally northward to Kamchatkan waters on the 6th to 8th. On the 3d it caused gales of forces 8–9 that were experienced as far south as the twenty-eighth parallel, near longitude 149° E., and on the 4th, gales of forces 8–10 scattered within the region 30° to 50° N., 160° to about 170° E. In northwestern waters the central pressures of the cyclone fell below 29 inches on the 4th and 5th, accompanied by strong winds, rising locally to force 9. Thereafter the disturbance did not strongly affect the main steamer routes.

During the period 9th to 14th there was scattered stormy weather within the approximate area 33° to 50° N., 143° to 165° E. Most of the gales encountered were of forces 8–9, but a force 10 gale was experienced by the Danish motorship *Grete Maersk* on the 14th, near 43° N., 160° E.

From the 15th to 22d, although low pressure areas of great extent lay over eastern waters from the Hawaiian Islands northward, and continued to the westward of midocean, no winds of force as high as 8 were reported. On the 23d, however, in the east longitude area, pressure began falling more rapidly and gale winds set in locally on the 23d. From then until the 27th considerable storminess developed, particularly to the southward and eastward of the storm center, which was situated between about 42° to 50° N., 160° to 175° E., on those dates. Gales were reported principally from the region 30° to 35° N., 150° to 170° E., but isolated gales of force 9 occurred on the 24th and 25th as far to the eastward as longitude 165° W., near latitude 40° N. The most violent gales of the period were of short-lived hurricane force, encountered by the Norwegian motorship *Sangstad* near 34° N., 152° E., on the 24th, and near 34° N., 161° E., on the 26th. After the 27th storminess abated.

On the eastern side of the Pacific the only stormy period of the month was that of the 8th to 10th, in connection with a cyclonic disturbance central in American coast waters. Gales of forces 8–9 were experienced on the 8th and 9th along the eastern two-thirds of the Californian-Hawaiian routes, and a gale of force 10 was reported by the *Swiftsure Bank* Lightship, at the entrance to the Strait of Juan de Fuca, on the 10th.

Gales in the Tropics.—In the Gulf of Tehuantepec northerly winds of force 7 occurred on the 17th and 20th, and of force 8 on the 19th and 22d. A gale of force 8 was experienced by the U. S. S. *Detroit* on the 10th in 10°30′ N., 89°42′ W.

Fog.—Fog was reported on 8 days off the Washington coast; on 4 days off the Oregon coast; and on 5 days off the California coast. A greater expanse of ocean had fog than in any previous month since September 1938. The observations of fog were well distributed over both northern and middle routes through March, with the westernmost, on the 13th and 14th, near 41°–42° N., 160°–165° E. In open sea, fog was most frequent over the small region between 38° and 42° N., 150° and 155° W., where it was reported on 4 days. Dense fog occurred on the 27th west of Costa Rica in about 10° N., 88° W.

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

TABLE 1.—*Condensed climatological summary of temperature and precipitation by sections, March 1939*

[For description of tables and charts, see REVIEW, January, p. 27]

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	59.4	+3.6	Robertsdale	89	23	St. Bernard	16	17	5.15	−0.60	Greensboro	9.49	Robertsdale	1.44
Arizona	52.0	−.3	2 stations	96	[1]17	Fort Defiance	−6	6	.68	−.37	Bright Angel Ranger Station.	3.08	2 stations	.00
Arkansas	55.4	+2.7	3 stations	88	23	Lead Hill	19	16	3.71	−1.00	Arkansas City	7.65	Fort Smith	1.24
California	50.2	−1.1	2 stations	97	[1]17	Soda Springs	−14	4	2.90	−.79	Bowman Dam	12.55	5 stations	T
Colorado	35.6	+1.0	Las Animas	83	22	Fraser	−29	2	1.14	−.17	Silver Lake	3.14	La Veta Pass	.10
Florida	68.2	+2.8	2 stations	94	[1]5	Vernon	30	29	1.54	−1.56	Merritts Island	5.24	Bradenton	T
Georgia	58.8	+2.4	Alapha	89	24	Blairsville	17	19	4.42	−.40	Concord	8.70	Brunswick	.84
Idaho	36.8	+1.1	Riggins	82	22	Island Park Dam	−24	5	1.29	−.51	Pierce	7.30	Arco	.00
Illinois	43.5	+2.6	2 stations	88	[1]23	Mount Carroll	3	7	3.36	+.18	Grand Chain	6.04	Oregon	1.15
Indiana	43.0	+2.2	Shoals	87	[1]24	Goshen	0	19	3.97	+.21	Vevak	8.54	Albion	.63
Iowa	36.4	+1.8	3 stations	86	23	Red Oak	−9	1	1.79	+.06	Ottumwa	5.32	2 stations	.29
Kansas	45.5	+2.1	Jetmore	88	22	2 stations	−6	1	1.72	+.28	Horton	4.40	Kismet (near)	.63
Kentucky	49.4	+3.0	Calhoun	90	23	do	15	19	5.78	+1.06	Falmouth	8.56	Jenkins	3.33
Louisiana	62.7	+2.0	2 stations	90	[1]23	do	29	17	2.89	−1.78	Urania	11.71	Franklin	.29
Maryland-Delaware	44.2	+1.8	College Park, Md	90	25	Oakland, Md	−3	19	3.92	+.35	Millsboro, Del	6.91	Keedysville, Md	1.61
Michigan	28.6	−.9	Morenci	82	24	Sidnaw	−40	18	1.76	−.36	L'Anse	5.62	Hart	.33
Minnesota	25.2	−1.4	Canby	84	23	Meadowlands	−41	18	.61	−.56	Mizpah	2.09	Roseau	T
Mississippi	59.8	+2.8	Yazoo City	90	23	6 stations	28	17	5.55	−.18	Brookhaven	10.05	Biloxi	1.48
Missouri	47.1	+3.1	Unionville	89	22	Edgerton	−4	1	3.08	−.18	Wappapello Dam	6.04	Kansas City Univ.	1.11
Montana	33.2	+2.1	Forsyth	80	23	Outlook	−28	15	.72	−.27	Heron	3.49	Jordan	T
Nebraska	39.7	+3.2	Norfolk	89	[1]22	2 stations	−7	[1]1	1.21	+.11	Auburn	4.26	Greeley	T
Nevada	42.7	+2.2	Las Vegas Airport	88	19	Ely	−9	1	.95	−.04	Kimberly	2.64	Gerlach	.20
New England	27.7	−4.5	Norwalk, Conn.	71	27	Fort Kent, Maine	−27	10	4.01	+.64	Plymouth, Mass.	8.52	Moosehead, Maine	1.21
New Jersey	40.1	+1.0	2 stations	83	25	Sussex	2	15	4.83	+1.05	Pleasantville	7.05	Sussex	2.70
New Mexico	44.4	+.6	Hobbs	90	26	Gavilan	−28	6	.76	+.01	Tajique	2.55	3 stations	.00
New York	30.0	−2.2	2 stations	77	26	Stillwater Reservoir	−26	19	3.17	+.12	Bridgehampton	6.37	Whitehall	1.58
North Carolina	53.1	+3.1	do	89	[1]25	Mount Mitchell	5	[1]19	3.80	−.40	Highlands	8.11	Marion	1.10
North Dakota	23.3	−.5	do	83	23	Pembina	−29	7	.39	−.37	3 stations	1.30	Hannah	.00
Ohio	40.8	+1.9	3 stations	85	24	Jefferson	−1	19	4.09	+.66	Dam No. 28	7.61	Springfield No. 1	2.30
Oklahoma	54.3	+3.4	Chattanooga	90	14	Kenton	1	2	1.89	−.31	Carnasaw Tower	5.26	Kenton	.47
Oregon	42.4	+1.4	2 stations	84	[1]17	Seneca	−26	5	2.23	−.55	McNamurs	8.82	Warmspring Reservoir.	.06
Pennsylvania	38.6	+.9	do	85	25	Corry	−10	19	3.59	+.09	Clarion	5.75	Wernersville (near)	1.98
South Carolina	57.8	+3.1	4 stations	88	[1]24	Longcreek (near)	19	19	3.47	−.43	Edgefield	6.01	Miley	1.60
South Dakota	33.9	+2.6	Pukwana	91	24	2 stations	−13	[1]17	.35	−.75	Harveys Ranch	1.76	McIntosh	.00
Tennessee	52.2	+2.7	Union City	87	23	do	14	[1]3	5.05	−.32	Coldwater	7.95	Kingsport	2.78
Texas	60.7	+2.2	2 stations	102	27	Stratford	6	2	1.04	−.99	Honey Grove	5.34	4 stations	.00
Utah	39.2	+.8	St. George	85	20	Woodruff	−23	1	.94	−.48	Mount Baldy Ranger Station	2.78	Callao	.10
Virginia	47.9	+2.0	Diamond Springs	88	25	Big Meadows	8	19	3.15	−.55	Clarksville	6.28	Timberville	1.54
Washington	41.9	+.5	Benton City	84	24	Chesaw	−2	5	2.45	−1.09	Wynoochee Oxbow	14.50	Ruff	.05
West Virginia	44.9	+2.4	London Locks	87	25	Alpena	3	19	4.20	+.26	Greenbottom	7.81	Petersburg	1.48
Wisconsin	28.7	−.7	3 stations	81	23	Long Lake	−36	18	1.01	−.73	Plum Island	4.23	Stanley	.22
Wyoming	32.2	+2.4	Hampshire	79	23	Triangle F Ranch	−26	5	.68	−.48	Bechler River	3.09	Eden	T
Alaska (February)	10.9	+4.0	Tree Point	55	12	Fort Yukon	−60	[1]7	2.21	+.30	Little Port Walter	16.94	Nenana	T
Hawaii	69.4	+.6	Kaanapali	94	19	Kanalohuluhulu	41	23	11.02	+2.82	Mountain View	42.36	Hoolehua	1.14
Puerto Rico	72.2	−1.1	6 stations	90	[1]10	Cayey	47	11	3.78	+.16	Maricao	15.52	Potala	.10

[1] Other dates also.

TABLE 2.—*Climatological data for Weather Bureau stations, March 1939*

[Compiled by Annie E. Small, by official authority U. S. Weather Bureau]

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	° *F.*	° *F.*	° *F.*		° *F.*	° *F.*		° *F.*	° *F.*	° *F.*	° *F.*	%	*In.*	*In.*		*Miles*								*0–10*	*In.*	*In.*
New England							**30.8**	**−1.9**										**72**	**4.66**	**+1.2**										**5.9**		
Eastport	75	67	85	29.93	30.02	+0.09	26.0	−2.9	48	27	33	−4	8	19	8	23	17	69	3.65	−0.2	12	12.4	nw.	46	e.	13	12	6	13	5.7	19.7	3.2
Greenville, Maine	1,069	4	41	.....	.....	.....	17.4	.....	42	5	31	−19	19	4	47	15	12	...	2.22	.....	14	.....	nw.	20	n.	14	...	...	...	...	24.5	30.0
Portland, Maine	103	82	117	29.92	30.05	+.09	29.2	−2.6	48	24	36	5	8	22	23	25	19	69	8.00	+4.1	18	9.6	n.	33	ne.	13	13	6	12	5.4	30.9	.8
Concord	289	54	72	29.73	30.06	+.06	28.2	−2.6	55	24	37	2	8	19	35	...	...	...	3.16	+.1	14	6.7	nw.	26	nw.	7	11	6	14	5.7	20.0	.8
Burlington	403	11	48	29.60	30.06	+.06	24.0	−5.1	52	26	33	−7	11	15	32	21	17	77	2.24	+.2	15	9.7	s.	31	w.	7	6	7	18	6.9	11.9	T
Northfield	876	12	60	29.07	30.06	+.06	22.0	−4.4	47	6	33	−14	11	11	36	20	17	80	2.12	−.4	18	7.9	sw.	30	sw.	1	5	11	15	6.6	17.3	1.5
Boston [1]	29	33	62	30.01	30.04	+.07	33.2	−2.4	58	6	40	9	11	26	23	29	23	69	5.23	+1.7	15	12.6	nw.	42	ne.	12	9	5	17	6.5	16.5	.0
Nantucket	12	14	90	30.01	30.03	+.05	35.8	+.3	56	27	42	20	10	30	20	33	29	77	7.27	+3.5	14	15.7	nw.	43	n.	13	10	6	15	6.2	8.8	.0
Block Island	26	11	46	30.01	30.04	+.06	35.6	+.2	61	27	42	13	11	29	24	33	28	73	4.70	+.9	13	18.0	nw.	44	nw.	13	14	6	11	5.0	4.3	.0
Providence	159	215	251	29.87	30.05	+.07	34.6	−1.1	61	24	42	7	11	27	24	31	25	70	4.62	+1.1	14	13.0	nw.	45	nw.	7	11	8	12	5.4	16.5	.0
Hartford	159	66	106	29.89	30.07	+.08	34.0	−1.0	62	24	41	9	11	27	27	...	...	...	4.59	+.7	13	8.0	nw.	26	nw.	13	10	6	15	6.1	15.2	.0
New Haven	106	74	153	29.95	30.08	+.09	36.1	+.3	66	27	43	11	11	29	28	31	24	66	5.66	+1.6	14	9.9	n.	31	nw.	13	10	8	13	5.6	9.6	.0
Middle Atlantic States							**42.3**	**+1.6**										**66**	**3.53**	**+0.1**										**6.0**		
Albany [1]	292	26	40	29.74	30.07	+.06	28.2	−4.5	60	26	37	−10	11	19	34	25	19	71	3.06	+.4	16	10.6	nw.	35	w.	7	9	7	15	6.6	20.1	.0
Binghamton	871	57	79	29.11	30.07	+.05	32.8	+.2	77	26	42	8	19	23	40	28	23	71	3.32	+.7	20	7.3	nw.	32	sw.	6	4	6	21	7.9	11.9	.0
New York	314	415	454	29.71	30.06	+.06	38.8	+1.1	70	24	47	18	11	31	34	34	29	64	4.81	+1.2	12	15.6	nw.	57	nw.	6	6	10	15	6.4	4.4	.0
Harrisburg [1]	374	94	104	29.70	30.09	+.06	40.7	+1.8	81	25	51	17	19	31	47	34	28	66	2.55	−.5	12	9.9	nw.	41	nw.	9	10	9	12	6.0	2.2	.0
Philadelphia	114	174	367	29.95	30.08	+.06	41.7	+.9	81	25	50	21	11	33	38	36	30	66	4.32	+.9	14	13.5	nw.	36	n.	25	8	9	14	6.1	4.0	.0
Reading	323	283	306	29.73	30.09	.....	40.2	+.2	80	25	49	17	19	31	34	34	27	61	2.59	−.9	12	13.1	nw.	41	nw.	9	7	13	11	5.9	3.3	.0
Scranton	805	72	104	29.18	30.06	+.04	35.4	−.3	74	26	44	11	19	27	35	31	24	64	2.58	−.6	12	7.7	nw.	31	sw.	6	6	11	14	6.3	6.4	T
Atlantic City	52	37	172	30.02	30.08	+.06	42.0	+3.4	74	25	49	23	19	35	29	37	32	70	6.04	+2.4	13	16.8	w.	46	nw.	13	7	8	16	6.4	1.3	.0
Sandy Hook	22	10	57	30.04	30.09	.....	39.0	−.3	68	27	46	19	11	32	28	35	30	74	3.99	.0	13	15.6	w.	43	w.	6	9	7	15	6.2	2.6	.0
Trenton	190	89	107	29.86	30.07	.....	39.6	+.5	70	24	48	18	11	31	35	35	28	66	4.39	+1.0	14	10.0	nw.	27	nw.	13	5	11	15	6.7	3.7	.0
Baltimore	123	100	215	29.95	30.08	+.05	45.2	+2.9	85	25	54	22	19	37	44	38	30	60	3.75	.0	13	11.3	sw.	38	sw.	6	11	9	11	5.3	.2	.0
Washington	112	62	85	29.95	30.08	+.04	46.4	+3.8	85	26	56	23	19	37	43	39	30	58	2.89	−.9	10	8.0	nw.	34	nw.	13	12	7	12	5.3	T	.0
Cape Henry	18	8	54	30.06	30.08	.....	51.4	+4.8	86	25	60	32	19	43	34	46	43	79	3.27	−.6	9	13.1	n.	37	n.	21	11	6	14	5.5	T	.0
Lynchburg	686	144	184	29.34	30.10	+.05	50.0	+2.7	83	24	60	23	3	39	44	42	33	58	3.21	−.3	10	8.1	sw.	31	nw.	13	11	10	10	5.2	T	.0
Norfolk	91	80	125	30.00	30.10	+.07	52.4	+4.2	84	25	62	32	2	43	39	44	39	69	2.40	−1.4	10	10.8	ne.	32	w.	27	10	4	17	6.3	3.2	.0
Richmond	144	11	52	29.94	30.10	+.06	49.4	+2.2	84	25	60	25	19	39	43	42	36	67	4.39	+.7	10	8.9	sw.	27	w.	9	13	6	12	5.0	.3	.0
Wytheville	2,304	49	55	27.66	30.09	+.04	45.8	+3.5	75	24	56	22	19	36	36	39	32	65	2.43	−1.0	13	8.3	w.	27	w.	5	10	8	13	5.6	1.3	.0
South Atlantic States							**58.2**	**+4.4**										**69**	**2.69**	**−1.1**										**4.7**		
Asheville	2,253	89	104	27.74	30.13	+.07	49.1	+4.2	77	25	60	24	19	38	36	41	35	66	2.56	−1.4	11	10.0	nw.	30	nw.	12	11	10	10	5.1	4.0	.0
Charlotte	779	63	86	29.26	30.10	+.05	55.4	+5.0	84	24	66	29	3	45	31	46	38	59	5.00	+.8	12	8.3	sw.	28	sw.	30	9	11	11	5.5	1.4	.0
Greensboro [1]	886	6	56	29.16	30.10	.....	51.4	.....	83	24	63	22	3	40	38	43	38	69	2.55	.....	9	9.0	sw.	29	sw.	30	10	6	15	5.8	.2	.0
Hatteras	11	5	50	30.06	30.10	+.06	55.9	+3.9	74	27	63	38	19	49	23	52	49	81	2.83	−1.4	9	15.2	sw.	37	n.	2	15	7	9	4.4	.0	.0
Raleigh	376	103	140	29.68	30.09	+.04	54.9	+4.7	87	25	66	27	3	44	36	47	42	71	2.61	−1.3	11	10.1	sw.	27	nw.	13	15	11	5	4.1	T	.0
Wilmington	72	73	107	30.03	30.11	+.06	58.6	+5.3	83	24	68	32	3	49	32	51	47	73	2.80	−.4	8	10.7	sw.	37	sw.	30	14	9	8	4.3	T	.0
Charleston	48	11	92	30.07	30.12	+.06	61.5	+4.1	83	24	70	36	3	54	28	55	51	77	1.87	−1.2	6	11.1	sw.	26	sw.	27	12	10	9	4.7	.0	.0
Columbia, S. C	347	70	91	29.73	30.12	+.06	59.2	+4.0	84	24	70	30	3	49	34	49	41	60	1.85	−1.6	9	9.0	sw.	32	sw.	12	16	7	8	4.1	.0	.0
Greenville, S. C	1,040	70	78	28.99	30.09	.....	55.3	+5.4	82	24	66	30	3	45	34	46	38	61	3.88	−1.3	11	7.7	sw.	28	w.	18	12	8	11	5.2	T	.0
Augusta	182	62	77	29.90	30.10	+.04	60.0	+4.0	85	24	71	32	3	49	36	51	44	64	3.15	−1.0	9	6.2	nw.	28	sw.	12	14	6	11	4.6	.0	.0
Savannah	65	73	152	30.04	30.11	+.05	63.7	+4.7	87	24	74	39	3	54	32	55	51	74	1.58	−1.5	5	11.4	sw.	28	sw.	12	14	9	8	4.6	.0	.0
Jacksonville	43	86	110	30.08	30.12	+.06	66.2	+3.6	85	29	76	42	17	56	29	57	53	74	1.43	−1.5	8	8.2	sw.	32	w.	27	13	12	6	4.5	.0	.0
Florida Peninsula							**73.6**	**+3.7**										**76**	**0.80**	**−1.2**										**2.8**		
Key West	21	10	64	30.06	30.08	+.03	76.6	+4.0	86	31	82	65	14	71	15	68	65	75	.08	−1.3	4	10.2	se.	24	nw.	13	26	5	0	2.1	.0	.0
Miami	25	124	168	30.08	30.11	+.03	74.0	+3.8	87	31	80	57	14	68	22	66	63	74	1.32	−.8	5	9.6	se.	26	s.	15	20	7	4	3.1	.0	.0
Tampa	35	88	197	30.08	30.11	+.04	70.2	+3.4	87	29	80	51	20	60	29	62	59	78	1.00	−1.4	3	10.8	s.	25	sw.	12	16	13	2	3.2	.0	.0
East Gulf States							**60.7**	**+3.0**										**68**	**3.85**	**−1.5**										**4.6**		
Atlanta [1]	976	5	72	29.07	30.11	+.05	55.8	+3.8	84	24	67	30	19	44	36	47	41	67	4.48	−.8	12	10.7	nw.	43	se.	30	14	8	9	4.6	.0	.0
Macon	370	79	87	.....	30.12	+.06	59.6	+2.9	84	24	72	32	12	48	40	...	...	64	5.07	+.1	8	7.3	nw.	25	sw.	12	12	8	11	...	...	.0
Thomasville	273	49	58	29.83	30.13	+.07	63.2	+3.0	86	24	74	38	17	52	35	55	50	...	1.60	−2.5	7	.....	sw.	...	...	...	16	9	6	3.9	.0	.0
Apalachicola	35	11	.....	30.08	30.12	.....	63.5	+1.9	80	22	71	45	20	56	25	58	55	82	.71	−3.5	2	7.9	s.	29	sw.	30	9	9	13	5.5	.0	.0
Pensacola	56	149	185	30.06	30.12	+.06	62.3	+2.0	82	23	69	45	17	56	23	56	51	73	.89	−3.9	5	12.7	s.	34	sw.	12	13	8	10	4.6	.0	.0
Anniston	741	9	.....	.....	.....	.....	57.2	+4.7	84	24	69	28	19	45	42	...	...	...	5.40	−.2	12	.....	nw.	...	...	...	12	8	11	...	...	.0
Birmingham	700	11	48	29.36	30.10	+.04	58.2	+2.8	82	24	69	32	19	48	35	49	42	63	4.35	−1.4	12	7.9	s.	25	se.	26	11	11	9	4.7	.0	.0
Mobile	57	86	161	30.05	30.12	+.06	62.3	+2.6	85	23	72	40	20	53	31	55	50	71	2.11	−3.9	7	10.3	s.	31	s.	30	14	11	6	3.7	.0	.0
Montgomery	218	92	105	29.87	30.12	+.06	61.0	+3.2	84	24	72	37	19	50	30	52	44	63	5.63	−.4	9	7.6	n.	25	s.	26	13	9	9	4.8	.0	.0
Meridian	375	67	92	29.70	30.11	+.06	59.7	+2.6	85	23	72	33	17	48	37	51	45	67	6.31	+1.1	9	6.6	ne.	23	sw.	11	16	7	8	3.9	.0	.0
Vicksburg	247	82	102	29.83	30.09	+.05	61.6	+3.1	84	23	71	39	17	52	29	52	43	59	5.70	+.1	7	9.4	s.	30	w.	12	10	11	10	5.2	.0	.0
New Orleans	53	76	84	30.06	30.11	+.07	66.0	+3.2	84	5	75	46	17	58	23	58	52	68	1.20	−3.5	6	7.8	ne.	18	ne.	16	14	11	6	4.1	.0	.0
West Gulf States							**61.8**	**+2.6**										**66**	**1.22**	**−1.7**										**5.4**		
Shreveport	249	92	227	29.82	30.09	+.07	62.0	+3.7	83	22	72	33	2	52	31	53	46	61	.85	−3.3	6	11.7	s.	31	sw.	11	10	12	9	5.4	.0	.0
Bentonville	1,303	12	38	28.72	30.10	+.09	51.8	+4.5	79	22	63	22	1	41	39	...	...	...	2.13	−1.9	9	7.7	sw.	31	sw.	11	13	9	9	...	...	.0
Fort Smith	463	57	82	29.59	30.07	+.06	56.4	+3.8	82	24	68	29	15	45	36	48	40	59	1.24	−1.8	7	8.1	e.	34	se.	28	11	13	7	5.0	.0	.0
Little Rock	357	94	102	29.70	30.08	+.05	56.4	+3.4	82	23	66	32	1	47	33	48	39	58	2.47	−2.2	7	8.9	s.	33	w.	12	13	4	14	5.2	.0	.0
Austin	605	68	90	29.40	30.04	.....	63.2	+2.5	91	27	75	38	2	52	39	55	47	62	1.04	−1.3	3	8.2	s.	29	sw.	11	8	12	11	5.7	.0	.0
Brownsville	57	88	96	29.93	29.99	.....	69.8	+1.6	90	26	78	49	13	62	29	64	61	79	.22	−1.0	5	12.3	se.	35	se.	11	8	16	7	5.2	.0	.0
Corpus Christi	20	11	78	30.00	30.02	+.04	67.2	+2.2	94	26	73	47	2	61	28	62	60	83	.86	−.7	5	13.0	s.	32	s.	11	10	11	10	5.7	.0	.0
Dallas	512	220	227	29.49	30.04	.....	59.6	.....	85	31	70	34	2	49	33	51	42	56	2.49	−.4	7	13.2	se.	43	w.	11	11	6	14	5.6	.0	.0
Fort Worth	679	92	110	29.35	30.07	+.09	60.1	+2.4	87	31	72	31	2	48	36	...	...	...	1.64	−.7	6	11.2	s.	35	w.	11	15	9	7	3.9	.0	.0
Galveston	54	106	114	30.01	30.07	+.06	63.8	+1.4	76	29	68	44	2	59	19	60	57	83	.31	−2.4	5	11.6	s.	26	se.	25	9	17	5	4.8	.0	.0
Houston	138	157	190	29.93	30.08	.....	64.6	+1.3	88	26	73	39	2	56	26	...	...	...	.63	−2.9	10	11.4	se.	30	s.	11	10	6	15	6.1	.0	.0
Palestine	510	64	72	29.54	30.08	+.08	60.8	+1.7	83	27	70	33	2	51	31	52	44	60	1.84	−1.6	5	8.6	s.	28	s.	11	10	6	15	5.6	.0	.0
Port Arthur	34	59	134	30.05	30.08	.....	63.9	.....	80	27	72	41	2	56	26	...	...	...	.75	−2.5	8	13.9	s.	32	s.	11	9	11	11	5.8	.0	.0
San Antonio	693	111	301	29.30	30.02	+.04	65.4	+2.6	93	26	76	42	2	55	37	54	45	55	.65	−1.2	3	12.0	e.	34	se.	27	7	15	9	5.7	.0	.0

[1] Observations taken at airport.

TABLE 2.—*Climatological data for Weather Bureau stations, March 1939*—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
Ohio Valley and Tennessee	*Ft.*	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	*° F.*	*° F.*	*°F.*		*°F.*	*° F.*		*°F.*	*° F.*	*° F.*	*° F.*	*%*	*In.*	*In.*		*M.*							*0–10*	*In.*	*In.*
				47.4				**+3.1**										**64**	**4.45**	**+0.2**									**5.5**		
Chattanooga	762	71	214	29.29	30.11	+0.05	54.9	+3.7	84	24	66	30	19	44	37	47	39	61	4.40	−1.4	13	9.0	ne.	35	w.	12	10	10	11	5.4	T	0.0
Knoxville	995	66	84	29.18	30.10	+.04	51.9	+3.2	83	24	63	27	19	41	39	45	38	64	5.04	.0	13	6.6	w.	30	w.	12	12	7	12	5.4	0.5	.0
Memphis	399	78	86	29.66	30.08	+.04	56.0	+3.7	80	23	64	32	2	48	26	48	39	59	5.14	−.1	6	8.6	sw.	34	sw.	12	12	8	11	5.3	.0	.0
Nashville	546	168	188	29.52	30.12	+.07	53.2	+4.0	83	23	64	27	19	42	34	45	38	64	4.83	−.3	11	10.2	nw.	41	nw.	12	9	9	13	5.5	T	.0
Lexington	989	6	.....	.....	.....	.....	47.2	+3.5	82	24	59	18	19	35	39	.....	.....	.....	5.39	+1.1	10	.....	sw.	.....	.....	.....	10	7	14	.....	T	.0
Louisville	531	188	234	29.51	30.08	+.03	48.6	+3.2	81	23	59	24	17	38	35	41	34	62	7.11	+2.7	9	11.6	s.	34	w.	15	17	6	8	4.4	T	.0
Evansville	431	76	116	29.61	30.09	+.05	49.2	+3.3	81	23	58	25	17	40	32	42	35	63	4.34	+.2	11	10.2	sw.	33	sw.	11	10	12	9	5.4	T	.0
Indianapolis	822	98	129	29.17	30.08	+.04	43.8	+3.8	83	24	54	17	17	34	37	37	29	62	3.03	−.9	8	9.6	w.	30	nw.	15	9	9	13	5.6	.1	.0
Terre Haute	575	63	149	29.43	30.06	.....	45.4	.....	83	23	56	18	17	35	35	38	31	64	4.14	+.4	9	11.3	s.	31	sw.	15	13	8	10	4.6	.2	.0
Cincinnati	627	11	51	29.39	30.08	+.03	45.2	+4.3	82	24	56	18	19	35	42	38	31	64	6.93	+3.0	10	9.6	s.	31	w.	15	9	10	12	5.6	T	.0
Columbus	822	90	210	29.18	30.08	+.04	42.4	+3.3	81	24	52	16	19	32	39	36	30	67	2.41	−1.1	10	11.6	s.	37	sw.	6	8	12	11	5.8	T	.0
Dayton	900	186	213	29.09	30.06	.....	42.8	+2.3	81	24	53	17	19	33	38	37	30	65	2.79	−.9	10	12.1	w.	37	sw.	15	10	10	11	5.6	.1	.0
Elkins	1,947	65	83	28.01	30.09	+.04	43.0	+3.0	77	26	55	8	19	31	43	36	29	66	4.17	+.4	14	8.3	w.	28	w.	6	6	9	16	6.7	1.9	.0
Parkersburg	637	77	84	29.38	30.07	+.02	44.8	+2.0	81	24	56	16	19	34	42	39	32	67	4.20	+.7	10	7.7	se.	25	w.	6	9	11	11	5.2	T	.0
Pittsburgh [1]	1,273	39	54	28.68	30.06	+.02	40.0	+.4	79	24	50	12	19	30	36	34	26	64	2.86	−.2	13	13.1	sw.	45	sw.	1	7	10	14	6.3	.4	.0
Lower Lake Region							**32.8**	**0.0**										**74**	**2.86**	**+0.2**									**7.1**		
Buffalo	768	243	280	29.20	30.06	+.04	30.3	−0.8	60	26	37	5	19	24	30	27	23	77	2.94	+.4	20	15.9	w.	66	sw.	1	3	11	17	7.3	10.2	.0
Canton	448	10	61	29.56	30.06	.....	23.4	−4.3	55	26	33	−9	11	14	34	22	18	78	2.42	−.1	15	10.0	w.	38	w.	1	7	7	17	7.1	17.3	2.6
Ithaca	836	77	100	29.13	30.07	.....	32.2	+.4	75	26	41	8	19	23	35	28	25	78	2.82	+.5	19	10.6	nw.	29	nw.	7	1	11	19	7.7	9.6	.0
Oswego	335	71	85	29.68	30.07	+.06	29.2	−2.0	68	26	36	5	11	22	34	26	20	70	2.84	+.3	19	10.6	s.	32	w.	7	5	2	24	8.0	15.8	T
Rochester	523	86	102	29.49	30.08	+.06	31.2	−.6	71	26	38	8	19	25	35	27	22	72	2.56	−.2	18	9.8	w.	40	sw.	1	4	8	19	7.2	13.6	.0
Syracuse	596	65	79	29.39	30.05	+.03	31.2	−.4	74	26	39	5	11	23	34	.....	.....	.....	2.87	−.1	19	8.1	w.	26	w.	6	5	6	20	7.3	16.8	.0
Erie	690	57	81	29.27	30.06	+.04	34.4	+.9	75	26	42	6	19	26	36	30	27	78	3.75	+1.1	16	9.5	sw.	30	sw.	1	6	9	16	6.7	2.9	.0
Cleveland	762	267	318	29.21	30.05	+.02	37.5	+2.9	75	26	46	15	18	29	39	33	27	69	2.77	+.1	13	16.9	w.	47	w.	1	5	10	16	6.7	3.0	.0
Sandusky	629	5	67	29.35	30.05	+.02	37.1	+2.0	81	24	45	12	19	29	38	.....	.....	.....	3.13	+.4	12	11.0	w.	32	sw.	15	5	5	21	7.3	.5	.0
Toledo	628	79	87	29.37	30.07	+.04	35.6	+.3	80	24	43	11	18	28	37	32	27	72	3.17	+.6	10	11.5	w.	37	w.	15	8	10	13	6.2	2.6	.0
Fort Wayne	857	69	84	29.12	30.07	.....	38.2	+1.4	80	24	47	14	19	30	40	33	28	72	2.67	−.6	10	11.1	w.	35	w.	15	5	15	11	6.1	.6	.0
Detroit [1]	626	5	78	29.37	30.06	+.03	33.5	+.1	79	24	41	10	19	26	38	30	26	78	2.38	.0	16	11.8	w.	41	sw.	15	4	8	19	7.4	1.4	.0
Upper Lake Region							**28.1**	**0.0**										**76**	**1.74**	**−0.4**									**6.4**		
Alpena	609	13	89	29.37	30.06	+.03	24.5	−1.0	55	26	32	−6	8	16	32	22	18	76	1.25	−.7	9	12.1	nw.	35	sw.	15	10	7	14	6.0	9.6	T
Escanaba	612	41	49	29.38	30.07	+.03	23.2	−1.0	52	24	32	−11	18	15	33	20	15	74	1.90	.0	11	11.8	n.	42	nw.	15	6	12	13	6.6	20.0	T
Grand Rapids	707	70	244	29.26	30.05	+.02	34.2	+.8	78	24	42	9	18	26	36	30	26	75	1.21	−1.3	15	12.8	sw.	52	sw.	15	5	10	16	7.0	11.0	T
Lansing	878	5	90	29.08	30.05	.....	32.0	−.2	78	24	40	7	19	24	43	29	26	81	1.52	−.8	11	10.4	sw.	32	sw.	15	4	11	16	7.3	4.9	T
Ludington	637	5	54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Marquette	734	44	69	29.23	30.06	+.02	23.2	−1.6	58	23	31	−8	18	16	42	21	18	81	2.71	+.4	11	8.3	nw.	25	nw.	15	4	12	15	6.9	29.0	18.0
Sault Sainte Marie [1]	724	5	33	29.23	30.06	+.03	19.0	−2.6	50	23	29	−15	8	9	39	16	13	85	2.14	+.3	12	.....	nw.	.....	.....	.....	7	8	16	6.8	18.9	7.6
Chicago	673	7	131	29.32	30.06	+.03	38.2	+2.9	79	24	46	11	17	30	39	33	27	69	2.96	+.4	9	12.0	w.	35	w.	15	10	14	7	5.1	.3	.0
Green Bay	617	109	141	29.36	30.05	+.01	29.2	+.6	69	25	37	−2	18	21	32	26	20	71	.77	−1.3	8	12.2	sw.	38	w.	15	9	10	12	6.1	8.2	.0
Milwaukee	681	97	221	29.29	30.04	+.01	34.8	+2.7	76	24	42	8	18	27	38	30	25	69	1.54	−.9	6	13.9	w.	36	w.	15	5	10	16	6.8	10.1	T
Duluth	1,133	5	47	28.79	30.06	.00	22.6	−1.1	68	23	32	−10	17	14	31	20	16	82	1.42	−.1	5	13.3	ne.	42	ne.	14	12	7	12	5.4	13.7	T
North Dakota							**22.7**	**+0.3**										**78**	**0.33**	**−0.5**									**4.8**		
Moorhead, Minn	940	50	58	29.04	30.10	+.02	22.5	−.2	66	24	32	−9	18	12	39	21	18	84	.23	−.8	3	9.2	n.	22	nw.	26	8	10	13	6.2	3.5	.0
Bismarck	1,677	8	57	28.25	30.10	+.04	26.6	+2.4	79	24	38	−9	6	15	54	23	18	73	.21	−.7	5	8.2	nw.	27	nw.	31	13	13	5	4.1	3.8	.0
Devils Lake	1,478	11	44	28.45	30.10	+.05	20.4	+.6	70	23	30	−14	17	10	45	18	14	81	.19	−.6	3	9.6	nw.	29	ne.	14	9	9	13	5.7	2.1	T
Lemmon, S. Dak	2,602	4	38	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Grand Forks	833	12	67	.....	.....	.....	19.2	−3.2	61	23	30	−19	7	9	46	17	14	.....	.73	.0	3	9.5	n.	.....	.....	.....	.....	.....	.....	.....	8.7	.1
Williston	1,878	42	50	28.04	30.09	+.05	25.0	+2.1	73	23	36	−15	15	14	46	22	17	75	.29	−.4	5	7.6	sw.	30	nw.	25	20	7	4	3.2	2.9	.0
Upper Mississippi Valley							**39.0**	**+2.7**										**71**	**2.42**	**+0.1**									**5.1**		
Minneapolis, St. Paul, Minn [1]	848	32	61	29.12	30.06	+.01	29.4	−.2	78	25	39	−1	1	19	43	25	21	76	.61	−.8	8	11.2	nw.	33	n.	15	10	12	9	5.5	6.0	.0
Springfield, Minn	1,025	4	42	.....	.....	.....	32.1	.....	83	23	42	3	17	22	45	27	22	.....	.55	.....	5	7.8	nw.	.....	.....	.....	.....	.....	.....	.....	8.2	.0
La Crosse	714	11	48	29.27	30.07	+.03	33.2	+1.7	75	24	43	4	1	24	41	28	23	70	.49	−1.1	6	6.4	s.	22	nw.	31	11	8	12	5.4	3.6	.0
Madison	974	70	78	28.97	30.05	+.01	33.0	+2.4	76	24	42	4	18	24	38	29	25	75	1.25	−.8	7	10.1	w.	28	w.	15	7	9	15	6.6	12.3	.0
Charles City	1,015	10	51	28.95	30.08	+.03	32.6	+1.9	79	23	43	0	1	22	44	29	24	77	.75	−1.0	8	7.4	se.	23	n.	26	13	10	8	4.6	6.6	.0
Davenport	606	66	161	29.39	30.07	+.04	38.7	+2.6	83	23	48	9	1	29	42	34	28	70	2.92	+.6	10	11.6	w.	35	nw.	15	12	9	10	5.1	4.4	.0
Des Moines	861	5	99	29.13	30.06	+.02	37.6	+1.7	83	23	48	6	1	27	45	33	29	75	1.80	.0	7	10.6	nw.	32	nw.	14	11	10	10	5.0	7.9	.0
Dubuque	699	60	79	29.29	30.06	+.02	36.0	+2.0	82	23	46	8	1	26	46	31	26	70	1.59	−.4	8	7.2	nw.	25	nw.	15	11	11	9	5.2	11.8	T
Keokuk	614	64	78	29.39	30.06	+.03	42.4	+3.5	83	23	52	14	1	32	42	41	31	68	3.69	+1.3	10	9.2	sw.	29	nw.	15	14	5	12	5.0	T	.0
Cairo	358	87	93	29.69	30.08	+.04	51.7	+4.5	82	23	60	29	1	43	28	45	38	66	4.78	+1.0	11	10.1	s.	32	sw.	11	10	6	15	5.9	T	.0
Peoria	609	11	45	29.39	30.07	+.04	41.0	+4.0	82	23	51	13	17	31	42	36	31	72	3.24	+.5	8	8.5	w.	24	ne.	12	19	6	6	3.4	T	.0
Springfield, Ill	636	5	191	29.37	30.06	+.03	44.2	+4.0	83	23	54	17	17	34	43	38	32	67	4.56	+1.4	9	12.9	s.	34	w.	15	10	11	10	4.9	T	.0
St. Louis	568	179	303	29.44	30.06	+.03	48.2	+4.1	83	23	58	20	17	38	43	41	34	63	3.35	.0	10	12.6	nw.	33	sw.	14	18	5	8	4.2	.6	.0
Missouri Valley							**41.7**	**+3.5**										**67**	**1.61**	**−0.3**									**5.0**		
Columbia, Mo	784	6	66	29.22	30.07	+.04	46.4	+3.8	83	23	57	18	1	36	40	.....	.....	.....	2.66	−.3	8	9.3	s.	25	sw.	19	11	9	11	5.5	T	.0
Kansas City [1]	750	32	45	.....	30.05	+.03	45.9	+3.2	83	23	57	12	1	35	42	.....	.....	65	1.14	−1.4	10	10.4	sw.	34	nw.	14	11	10	10	.....	.3	.0
St. Joseph	967	11	49	29.00	30.06	.....	43.8	+3.3	84	23	54	8	1	33	40	38	31	67	4.69	+2.2	9	9.4	s.	31	nw.	14	14	8	9	4.7	T	.0
Springfield, Mo	1,324	5	78	28.64	30.06	+.04	49.0	+3.8	79	22	59	21	1	39	37	42	35	63	1.78	−1.6	11	9.4	s.	27	w.	5	14	8	9	5.0	1.7	.0
Topeka	987	65	87	28.97	30.04	.....	45.6	+3.0	84	22	57	8	1	34	42	39	32	64	1.27	−.8	9	9.7	s.	30	nw.	14	13	5	13	5.4	.2	.0
Lincoln	1,189	11	81	28.76	30.05	+.03	41.0	+3.5	83	23	52	11	1	31	37	35	29	68	2.10	+.8	8	10.2	s.	37	n.	11	13	6	12	4.9	5.8	.0
Omaha [1]	982	31	44	28.99	30.07	+.03	39.2	+2.2	83	23	50	9	1	28	45	34	29	71	.89	−.5	4	11.4	se.	42	nw.	14	13	8	10	5.0	5.9	.0
Valentine	2,598	47	54	27.28	30.05	+.02	37.0	+4.7	81	23	49	2	5	25	43	31	25	69	.47	−.6	4	8.7	w.	28	nw.	14	16	4	11	4.7	3.7	.0
Sioux City	1,138	64	106	28.82	30.07	+.02	36.4	+3.7	85	22	48	6	6	25	49	31	25	69	.96	−.2	6	9.4	nw.	39	nw.	14	14	8	9	4.8	6.8	T
Huron	1,307	59	74	28.65	30.07	+.01	32.8	+3.9	82	23	45	2	17	21	50	28	22	70	.12	−.8	3	12.4	nw.	35	n.	14	12	11	8	5.0	.9	.0
Northern Slope							**35.1**	**+3.3**										**64**	**0.84**	**−0.1**									**5.5**		
Havre	2,507	11	67	27.36	30.06	+.06	31.6	+4.5	76	24	45	−13	5	18	46	27	20	66	.24	−.3	7	9.8	e.	32	sw.	11	12	9	10	5.0	4.2	.0
Helena	4,124	85	111	25.78	30.05	+.04	34.6	+2.2	67	22	45	−6	5	24	38	29	20	55	.47	−.3	8	7.5	sw.	31	sw.	30	7	5	19	6.6	9.7	T
Missoula	3,238	80	91	.....	.....	.....	39.9	+4.3	71	23	50	11	5	29	40	.....	.....	.....	1.03	.0	7	7.3	e.	31	e.	26	9	5	17	6.5	5.1	.0
Kalispell	2,973	48	56	26.95	30.05	+.06	34.9	+2.0	66	24	45	4	4	25	37	31	26	71	.84	−.1	9	5.5	nw.	17	w.	18	7	3	21	6.7	12.6	.0
Miles City	2,371	48	55	27.50	30.05	+.03	34.6	+6.0	75	23	47	−2	5	22	40	29	21	63	.23	−.6	7	6.6	s.	24	nw.	30	7	12	12	6.0	2.6	.0
Rapid City	3,259	50	58	26.60	30.04	+.03	36.0	+3.4	78	23	47	5	5	25	41	30	22	62	.84	−.1	9	7.5	w.	32	nw.	30	12	11	8	4.9	9.0	.0
Cheyenne [1]	6,144	5	39	23.89	30.01	+.05	34.4	+1.3	66	25	46	−4	1	23	42	29	22	64	1.73	+.7	10	13.0	nw.	44	nw.	14	10	12	9	5.2	19.0	.0
Lander	5,352	60	68	24.60	30.00	+.01	35.2	+2.8	69	25	48	−5	1	22	37	29	19	53	.50	−.7	4	5.3	sw.	37	sw.	13	15	11	5	4.1	4.5	.0
Sheridan	3,790	10	47	26.08	30.05	.....	34.2	.....	74	23	48	−6	5	20	45	29	22	66	1.15	.0	8	5.2	s.	20	nw.	30	11	13	7	5.1	12.8	.0
Yellowstone Park	6,241	12	46	23.84	30.12	+.10	29.4	+2.2	60	24	40	−7	5	19	37	25	20	70	1.37	+.4	17	8.2	sw.	31	sw.	13	9	5	17	6.0	19.3	T
North Platte	2,821	11	51	27.06	30.04	+.04	40.5	+3.9	79	22	54	7	6	27	44	33	26	65	.88	.0	5	8.4	w.	31	n.	14	14	6	11	4.5	9.5	.0

[1] Observations taken at airport.

TABLE 2.—*Climatological data for Weather Bureau stations, March 1939*—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max.+mean min.÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F.*		°*F.*	°*F.*		°*F.*	°*F.*	°*F.*	°*F.*	%	*In.*	*In.*		*M.*								*0–10*	*In.*	*In.*
Middle Slope							**45.5**	**+2.3**										**60**	**1.22**	**0.0**										**4.5**		
Denver	5,292	106	113	24.68	30.01	+.06	40.3	+1.0	68	25	51	9	1	30	31	33	24	55	1.01	.0	8	8.4	s.	37	nw.	14	15	11	5	4.3	3.8	0.0
Pueblo	4,670	79	86	25.26	30.00	+.08	42.4	+.8	74	22	56	8	2	29	50	35	25	55	.57	.0	7	7.9	nw.	30	nw.	6	18	7	6	4.0	.6	.0
Concordia	1,392	50	58	28.55	30.05	+.04	43.0	+2.0	81	22	54	9	1	32	38	37	32	69	1.93	+.7	11	8.7	sw.	31	n.	11	12	7	12	5.1	8.0	.0
Dodge City	2,509	10	86	27.39	30.02	+.05	45.2	+2.4	78	22	58	11	1	33	39	38	32	66	1.06	+.2	5	11.4	sw.	41	ne.	11	15	6	10	4.7	2.8	.0
Wichita	1,358	85	93	28.58	30.03	+.04	48.0	+2.9	78	22	60	17	1	36	41	40	32	60	1.57	−.2	10	11.1	s.	35	sw.	11	14	6	11	4.8	1.5	.0
Oklahoma City	1,214	10	47	28.73	30.02	+.04	54.2	+4.2	83	22	67	23	2	41	45	45	34	56	1.16	−.8	4	10.3	s.	33	w.	11	16	5	10	4.3	.0	.0
Chadron, Nebr.	3,439	4	58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Southern Slope							**57.8**	**+3.3**										**45**	**0.79**	**−0.1**										**4.4**		
Abilene	1,738	10	56	28.20	30.00	+.04	60.6	+4.1	88	14	75	25	2	47	42	48	34	47	1.00	−.3	4	11.1	s.	36	nw.	11	10	10	11	5.2	.0	.0
Amarillo	3,676	10	49	26.25	29.99	+.04	51.4	+4.5	80	19	66	19	2	37	39	39	24	45	.25	−.5	5	10.3	s.	35	w.	11	15	12	4	4.0	1.2	.0
Del Rio	960	63	71	28.98	29.96	+.01	66.4	+2.9	96	27	78	42	2	55	40	53	40	47	.75	.0	4	10.1	se.	29	nw.	6	9	11	11	5.8	.0	.0
Roswell	3,566	75	85	26.36	29.97	+.07	53.0	+1.7	82	10	68	19	6	38	53	41	25	41	1.15	+.4	3	9.2	s.	40	nw.	11	22	6	3	2.7	.0	.0
Southern Plateau							**51.5**	**+1.4**										**45**	**0.54**	**−0.3**										**3.9**		
El Paso	3,778	82	101	26.18	29.95	+.07	58.2	+2.4	82	10	72	29	6	45	40	43	25	31	.44	+.1	2	9.2	w.	30	sw.	4	20	7	4	2.7	T	.0
Albuquerque [1]	5,134	5	39	25.05	29.98	.....	46.2	+.3	74	19	61	12	6	31	44	36	24	49	.67	+.2	6	9.2	n.	41	w.	5	11	12	8	4.4	.5	.0
Santa Fe	7,013	38	53	23.22	30.00	+.11	40.8	+1.1	64	19	52	8	6	30	34	32	21	48	.54	−.3	7	6.6	n.	22	nw.	5	11	11	9	4.9	1.3	.0
Flagstaff	6,907	10	59	23.32	29.94	+.03	37.4	+1.5	65	18	52	2	2	23	47	32	.....	69	.84	−1.7	8	8.1	sw.	25	sw.	4	8	11	12	5.6	4.5	.0
Phoenix	1,107	39	51	28.80	29.96	+.05	62.4	+1.7	91	16	77	36	1	48	43	48	32	38	.15	−.5	4	5.6	e.	30	sw.	10	18	6	7	3.8	.0	.0
Yuma	141	9	54	29.82	29.97	+.03	65.5	+1.4	94	18	80	38	11	51	40	50	34	37	.01	−.3	1	5.8	w.	28	n.	1	25	4	2	1.9	.0	.0
Independence	3,957	5	26	25.98	30.01	+.07	49.9	+1.4	78	17	63	20	4	37	41	39	24	.....	1.12	+.6	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.0	.0
Middle Plateau							**42.5**	**+1.8**										**60**	**0.89**	**0.0**										**4.7**		
Reno	4,527	61	76	25.46	30.02	+.04	45.3	+4.2	71	24	57	16	1	34	36	38	29	56	.90	+.1	7	7.3	w.	35	w.	13	13	11	7	4.4	2.0	.0
Tonopah	6,090	12	20	.....	.....	.....	41.8	.....	67	19	52	13	4	32	27	35	28	66	1.53	.....	8	.....	se.	.....	.....	.....	.....	.....	.....	.....	.....	T	.0
Winnemucca	4,344	18	56	25.62	30.04	+.03	42.0	+2.0	72	25	56	11	5	28	42	35	26	60	1.01	0	11	8.0	ne.	30	sw.	13	13	6	12	5.2	7.3	.0
Modena	5,473	10	43	24.60	29.97	+.01	40.1	+1.9	70	19	54	4	4	27	42	33	24	58	.62	−.4	9	9.4	sw.	30	sw.	26	10	13	8	4.5	2.5	.0
Salt Lake City [1]	4,227	32	46	25.74	30.04	+.06	41.6	.....	68	19	52	14	5	31	34	36	30	64	.78	.....	9	8.1	se.	31	w.	26	8	15	8	5.4	7.4	.0
Grand Junction	4,602	60	68	25.38	29.99	+.05	42.7	−.9	72	20	55	5	5	31	33	35	27	59	1.04	+.3	10	5.4	n.	24	sw.	26	17	8	6	3.9	3.2	.0
Northern Plateau							**43.9**	**+1.8**										**64**	**0.90**	**−0.2**										**6.2**		
Baker	3,471	36	54	26.47	30.08	+.05	39.7	+2.1	72	23	51	10	5	28	40	35	28	66	.36	−.7	8	6.4	se.	21	n.	27	11	2	18	6.0	7.3	.0
Boise	2,739	79	87	27.20	30.09	+.06	44.4	+1.7	71	22	55	16	5	34	32	38	30	60	.76	−.6	9	5.9	se.	23	nw.	13	10	7	14	5.6	3.6	.0
Pocatello [1]	4,466	5	31	25.48	30.05	+.04	38.6	.....	66	24	49	8	8	27	37	33	27	68	.57	.....	5	10.0	sw.	34	w.	13	9	9	13	5.6	9.0	.0
Spokane	1,929	101	110	27.98	30.07	+.06	41.2	+1.5	71	22	50	14	5	32	35	37	31	70	1.20	0	10	6.3	s.	18	s.	11	7	5	19	6.9	14.3	.0
Walla Walla	991	57	65	28.98	30.06	+.04	47.8	+1.7	77	24	56	24	4	40	29	42	34	62	1.84	+.2	11	5.8	s.	24	sw.	13	8	6	17	6.5	3.0	.0
Yakima	1,076	58	67	28.89	30.05	.....	46.2	+2.1	79	23	57	22	5	35	38	39	31	59	.32	−.1	9	5.3	nw.	23	w.	13	8	5	18	6.5	.2	.0
North Pacific Coast Region							**46.9**	**+1.4**										**74**	**3.13**	**−1.0**										**6.7**		
North Head	211	11	56	29.86	30.09	+.08	44.8	−.4	61	17	49	34	9	40	17	43	41	88	4.73	−.8	20	14.4	s.	53	s.	10	4	8	19	7.5	T	.0
Seattle	125	90	321	29.94	30.07	+.08	46.4	+1.5	71	22	53	33	4	40	28	42	37	72	2.07	−1.0	16	9.0	s.	34	sw.	10	5	7	19	7.1	.2	.0
Tacoma	194	172	201	29.87	30.08	+.08	45.0	+.8	71	22	52	30	5	38	28	.....	.....	.....	2.79	−.7	14	7.9	sw.	30	s.	10	5	4	22	7.4	T	.0
Tatoosh Island	86	9	55	29.96	30.06	+.10	43.4	+.5	52	29	47	35	4	40	12	41	38	82	5.28	−2.6	17	13.3	e.	40	e.	8	4	6	21	7.6	.1	.0
Medford [1]	1,329	29	58	28.66	30.04	.....	49.6	+2.7	83	22	64	25	1	35	44	43	35	64	1.52	−.2	6	.....	nw.	.....	.....	.....	13	5	13	4.8	T	.0
Portland, Oreg.	154	68	106	29.93	30.09	+.07	49.4	+2.5	76	22	58	32	10	41	30	44	39	71	2.29	−1.6	14	6.5	nw.	23	w.	12	7	9	15	6.3	T	.0
Roseburg	510	45	76	29.54	30.10	+.06	49.4	+2.3	79	22	61	29	1	38	38	44	38	68	3.20	−.1	11	4.3	nw.	21	sw.	13	11	5	15	6.0	T	.0
Middle Pacific Coast Region							**52.6**	**−0.1**										**71**	**3.44**	**−0.5**										**5.8**		
Eureka	60	72	88	30.06	30.13	+.07	48.0	−.3	71	17	53	34	14	43	21	45	42	82	5.03	−.2	15	7.3	n.	30	n.	3	7	9	15	6.8	.0	.0
Redding [1]	722	20	34	.....	.....	.....	55.6	+1.6	84	17	65	33	4	46	34	48	38	57	3.67	−1.0	10	8.3	nw.	31	se.	12	17	4	10	4.6	.0	.0
Sacramento	66	92	115	30.00	30.08	+.05	54.0	−.3	81	17	64	33	4	44	32	48	42	67	2.42	−.2	5	7.2	s.	22	nw.	3	10	10	11	5.4	.0	.0
San Francisco	155	112	132	29.93	30.10	+.04	52.8	−1.4	79	16	58	44	5	47	25	48	44	77	2.62	−.5	9	8.3	w.	26	w.	4	9	4	18	6.3	.0	.0
South Pacific Coast Region							**56.1**	**−0.3**										**70**	**1.50**	**−0.5**										**5.4**		
Fresno	327	97	105	29.72	30.08	+.07	56.2	+1.2	83	17	67	35	5	46	31	50	43	65	1.88	+.3	8	5.5	nw.	22	w.	25	13	10	8	4.6	.0	.0
Los Angeles	338	159	191	29.70	30.07	+.05	56.8	−.7	79	31	64	45	1	49	26	50	44	69	1.44	−1.3	3	5.7	sw.	18	se.	9	15	3	13	5.0	.0	.0
San Diego	87	62	70	29.98	30.07	+.05	55.2	−1.5	74	31	61	42	1	49	21	50	47	77	1.17	−.6	8	6.8	nw.	24	se.	9	8	8	15	6.5	.0	.0
West Indies																																
San Juan, P. R.	82	9	54	29.96	30.05	.....	74.1	−1.3	84	21	79	67	22	69	16	.....	.....	.....	1.86	−1.3	19	14.8	e.	33	e.	9	8	21	2	4.2	.0	.0
Panama Canal																																
Balboa Heights	118	6	92	.....	[2] 29.86	+.02	80.4	−.8	93	26	90	70	10	71	22	.....	.....	[2] 70	T	−.7	0	10.3	n.	33	nw.	9	22	9	0	3.4	.0	.0
Cristobal	36	6	97	.....	[2] 29.90	+.02	80.6	−.9	86	28	84	73	10	77	9	73	70	[2] 72	.64	−.9	14	14.8	n.	28	n.	10	11	17	3	4.7	.0	.0
Alaska																																
Fairbanks	454	11	87	.....	[3] 30.02	.....	4.5	−5.5	55	28	17	−31	8	−8	44	.....	.....	61	.48	−.2	7	6.5	n.	27	s.	30	9	6	16	.....	6.8	12.0
Juneau	80	98	116	[2] 29.83	[2] 29.92	.....	31.8	−1.9	44	29	36	16	16	28	19	30	24	73	9.09	+3.4	22	8.4	s.	28	e.	19	4	2	25	8.2	29.7	T
Nome	22	5	32	.....	[3] 30.05	.....	3.3	−4.7	34	28	15	−23	31	−8	42	.....	.....	70	.62	−.2	8	7.8	ne.	33	w.	28	17	3	11	.....	7.0	29.5
Hawaiian Islands																																
Honolulu	38	86	100	29.97	30.01	.....	72.6	+1.2	80	4	77	64	22	68	12	66	63	74	1.88	−1.3	12	9.6	e.	27	e.	6	8	15	8	5.4	.0	.0

[1] Observations taken at the airport.

[2] Observations taken bihourly.

[3] Pressure not reduced to a mean of 24 hours.

TABLE 3.—*Data furnished by the Canadian Meteorological Service, March 1939*

Stations	Altitude above mean sea level, Jan. 1, 1919	Pressure			Temperature of the air						Precipitation		
		Station reduced to mean of 24 hours	Sea level reduced to mean of 24 hours	Departure from normal	Mean max.+ mean min.÷2	Departure from normal	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure from normal	Total snowfall
	Feet	*In.*	*In.*	*In.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*In.*	*In.*	*In.*
Cape Race, Newfoundland	99												
Sydney, Cape Breton Island	48	29.80	29.94	+0.03	23.0	−4.2	31.0	14.9	48	−3	5.40	+0.81	19.9
Halifax, Nova Scotia	88	29.72	29.99	+.07	26.8	−3.6	32.4	21.1	50	5	6.52	+1.69	29.7
Yarmouth, Nova Scotia	65	29.89	30.01	+.07	28.4	−3.6	34.2	22.7	46	8	6.76	+2.65	38.3
Charlottetown, Prince Edward Island	38	29.90	29.98	+.07	21.0	−4.8	28.5	13.5	44	−5	4.72	+1.06	25.7
Chatham, New Brunswick	28	29.86	29.97	+.05	18.0	−6.5	28.8	7.2	42	−14	2.54	−.81	18.4
Father Point, Quebec	20	30.02	30.03	+.11	16.0	−5.6	24.0	8.0	39	−16	1.64	−1.28	16.4
Quebec, Quebec	296												
Doucet, Quebec	1,236	28.65	30.07	+.10	6.6	−7.0	21.3	−8.0	42	−50	.15	−1.58	1.4
Montreal, Quebec	187												
Ottawa, Ontario [1]	236	29.68	30.07	+.07	19.9	−4.2	28.7	11.1	44	−11	1.68	−.07	15.6
Kingston, Ontario	285	29.73	30.06	+.05	25.4	−1.8	32.0	18.7	44	2	2.22	−.25	16.9
Toronto, Ontario	379	29.62	30.05	+.02	28.7	−1.1	34.8	22.6	52	4	3.15	+.62	19.7
Cochrane, Ontario	930	29.01	30.09	+.03	7.2	−8.0	19.8	−5.3	48	−26	1.89	+.59	18.8
White River, Ontario	1,244	28.67	30.09	+.05	8.0	−5.3	24.2	−8.2	56	−49	2.45	+.95	24.5
London, Ontario	808	29.15	30.06		29.0	−.8	36.3	21.6	67	1	2.88	−.04	8.6
Southampton, Ontario	656	29.31	30.04	+.05	24.6	−2.6	31.3	17.9	57	−6	3.15	+.47	26.7
Parry Sound, Ontario	688	29.04	30.08	+.06	21.6	−2.2	30.6	12.6	51	−14	2.35	−.38	21.6
Port Arthur, Ontario	644	29.33	30.08	+.03	14.8	−5.5	25.5	4.0	46	−33	2.00	+1.06	20.0
Winnipeg, Manitoba	760	29.21	30.12	−.02	14.2	−1.6	23.6	4.7	53	−35	.06	−1.07	.6
Minnedosa, Manitoba	1,690	28.21	30.12	+.04	16.4	+1.4	26.0	6.7	60	−32	.09	−.74	.9
Le Pas, Manitoba	860	29.10	30.12	.00	7.6	−3.4	21.1	−5.8	53	−43	.43	−.14	4.0
Qu'Appelle, Saskatchewan	2,115	27.71	30.09	+.01	17.0	−.3	26.1	7.8	50	−22	.48	−.69	4.4
Moose Jaw, Saskatchewan	1,759	28.03	30.10	+.04	21.0	+1.2	30.7	11.2	65	−20	1.19	+.52	11.8
Swift Current, Saskatchewan	2,392	27.14	30.06	+.01	21.4	−.2	31.9	10.9	69	−18	.64	−.11	6.4
Medicine Hat, Alberta	2,365	27.48	30.06	+.04	24.6	−3.3	36.7	12.6	71	−17	.91	+.32	8.4
Calgary, Alberta	3,540	26.28	30.09	+.07	22.1	−3.0	34.5	9.7	67	−31	1.64	+.80	16.3
Banff, Alberta	4,521												
Prince Albert, Saskatchewan	1,450	28.49	30.12	+.05	13.0	−1.0	24.0	2.0	54	−31	.44	−.46	4.4
Battleford, Saskatchewan	1,592	28.28	30.10	+.05	13.1	−2.0	24.4	1.8	49	−34	.26	−.27	2.6
Edmonton, Alberta	2,150	27.70	30.07	+.10	20.2	−2.1	30.8	9.6	59	−24	.77	+.03	6.9
Kamloops, British Columbia	1,262												
Victoria, British Columbia	230	29.77	30.02	−.01	44.0	+.4	49.4	38.7	62	30	1.18	−1.20	T
Barkerville, British Columbia	4,180												
Estevan Point, British Columbia	20												
Prince Rupert, British Columbia	170												
St. Georges, Bermuda	158		30.16	+.08	64.1	+1.3	68.7	59.6	75	52	3.80	−.81	.0
LATE REPORTS FOR FEBRUARY 1939													
Cape Race, Newfoundland	99				21.4	−.5	28.7	14.1	40	3	3.39	−.56	7.6
Quebec, Quebec	296	29.70	30.05	+.04	11.8	+.3	19.3	4.3	38	−10	8.77	+5.64	82.4
Ottawa, Ontario [1]	236	29.67	30.06	+.02	11.8	−.4	23.6	.0	41	−20	3.35	+.86	30.8
Banff, Alberta	4,521	25.36	30.14	+.07	12.3	−4.0	24.1	.5	42	−36	.44	−.45	4.4
Kamloops, British Columbia	1,262	28.71	30.12	+.04	23.1	−3.7	30.9	15.3	46	−16	.17	−.53	1.7
Estevan Point, British Columbia	20	30.05	30.08	+.10	39.3	−1.7	44.4	34.2	63	26	11.18	−.05	.2
Prince Rupert, British Columbia	170	29.79	29.98	+.07	34.6	−2.0	39.6	29.6	47	10	11.03	+2.71	8.2
LATE REPORT FOR JANUARY 1939													
Southampton, Ontario	656	29.23	29.96	−.08	20.6	−.7	27.3	13.9	42	−.4	2.89	−.89	25.7

[1] Observations taken at airport.

TABLE 4.—*Severe local storms, March 1939*

[Compiled by Mary O. Souder from reports submitted by Weather Bureau officials]

[The table herewith contains such data as has been received concerning severe local storms that occurred during the month. A revised list of tornadoes will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Buffalo, N. Y.	1	Midnight–7 a. m.				Gale	Several plates glass windows broken: power and telephone poles and wires down; signs destroyed. A radio tower completely wrecked near the airport. Estimated loss, several thousand dollars.
Rochester, N. Y.	1					Wind	Considerable damage to wires, trees, signs, and awnings.
Wagner, Okla.	4	9:15 to 9:50 a. m.	[1] 2½			Heavy hail	Loss to crops, $5,000; property damage, $20,000; path 5 miles long.
Berryville and Alpena, Ark.	4	11 p. m.	880–1,320	1	$125,000	Tornado	20 persons injured; property damaged.
Boone County, Ark.	4	Midnight		0	20,000	do	Property damaged; path narrow and 30 miles long.
Siloam Springs, Ark.	4	P. m.			3,500	Wind	Large barn destroyed; livestock killed.
Lauderdale County, Ala., western portion.	5				2,000	do	Several persons injured; property damaged.
Sumter County, Ala., southwestern portion.	5				2,000	do	Property damaged; several injuries reported.
Dubuque, Iowa [2]	5					Snow and glaze	Glaze on streets and highways created a very hazardous condition for motorists and pedestrians.
Georgia: Acworth to Gainesville.	6	3 a. m.		0	7,500	Tornado	Property destroyed or damaged; chief loss in timber; path 40 miles long.
Perry County, Ind.	6				50,000	Heavy rain	Roads damaged; high water on the Wabash River caused much damage; some damage by high water from the White River.

See footnotes at end of table.

TABLE 4.—*Severe local storms, March 1939*—Continued

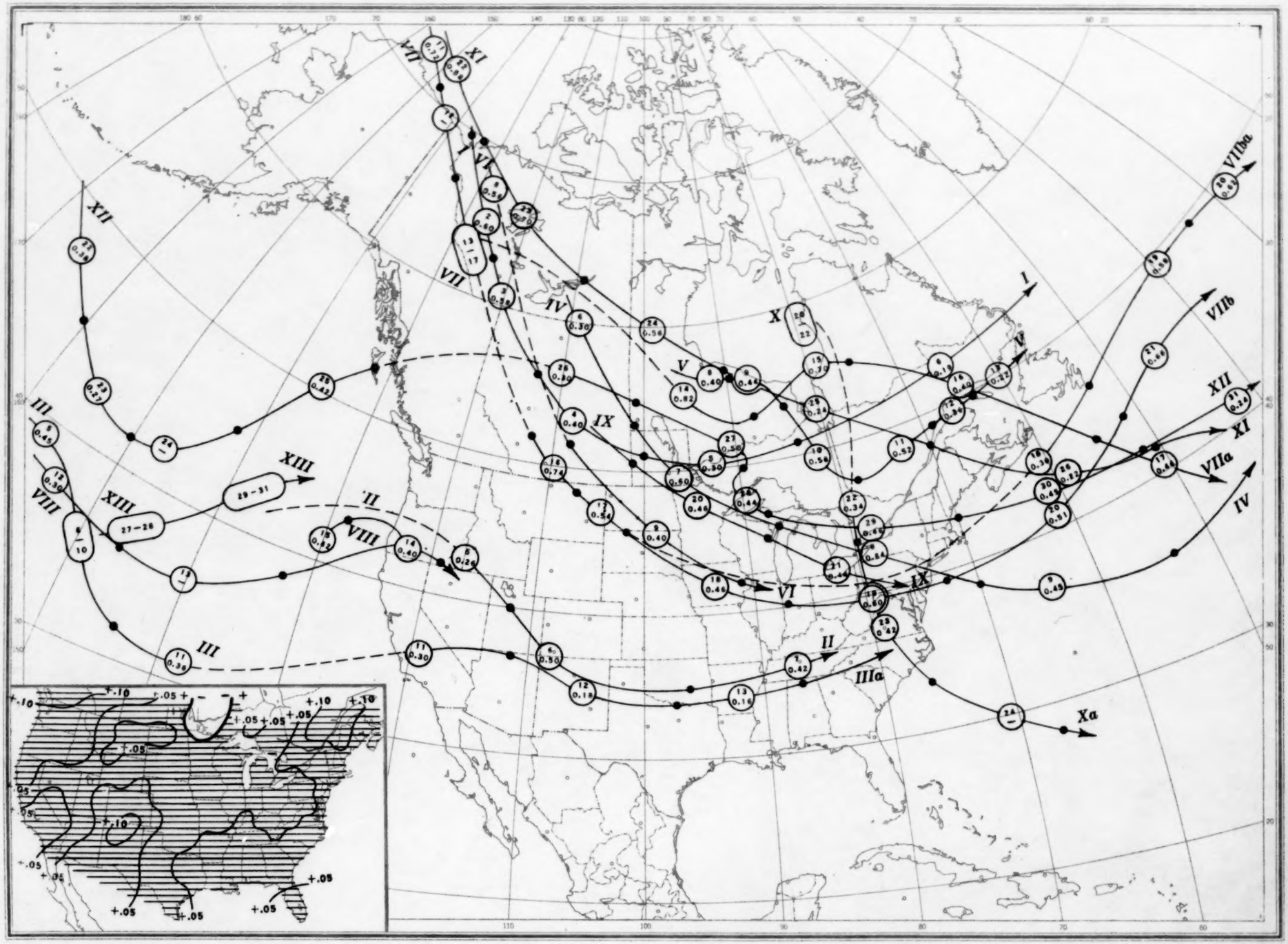
Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Buffalo, N. Y., and vicinity	6					Gale	Garage blown over; plate glass window shattered; small damage to roofs. One person injured.
Fort Pierce, Fla	8	5:30–6 p. m.	[1] 4	1	$12,000	Hail	Loss to crops; no property damage.
Mayflower, Ark	9	5:30–6 p. m.			500	do	Damage to windows, roofs, and automobile tops; path 5 miles long.
Riley and Pottawatomie Counties, Kans.	11	1–3 a. m.	[1] 15–20		25,000	Heavy hail	Occurred over practically all of Riley and the southwestern part of Pottawatomie County. Chief damage to greenhouses and roofs in Manhattan and Wamego. Damage to greenhouse on campus of Kansas State College, Manhattan, $10,000.
Leavenworth County, Kans.	11	3:35–5 a. m.	10		25,000	Heavy hail and wind.	Chief damage to buildings in Leavenworth and to farm property a short distance southwest of the city where a large barn was demolished.
Divernon, Ill	11				4,000	Electrical	Barn and contents burned.
Palmyra, Ill	11				2,000	do	Barn and contents destroyed.
Riddle Hill, Ill	11				3,000	do	Barn and livestock burned.
Wood River, Ill	11				25,000	do	Oil tank destroyed.
New York, N. Y. [2]	11			2	80,000	Snow	Many pedestrians injured in falls on slippery streets. 5,640 trees in the city's parks ruined with estimated damage of $80,000.
Steuben County, Ind	11–12				5,000	Glaze	Property damaged.
Lenawee, Branch, Hillsdale, Monroe, Wayne, Washtenaw, Jackson, Oakland, and Macomb Counties, Mich.	11–12				140,000	do	This storm reported to be the worst in 25 years in the southeast section of the State. Heaviest loss to telephone, telegraph, electric power and light companies. Severe breakage to old fruit trees especially in Branch, Hillsdale, and Lenawee Counties. Considerable damage to shade trees and shrubbery.
Toledo, Ohio [2]	11–12					Rain, ice, and wind.	Steady, rather heavy rain began 7:45 p. m., on the 11th. Power service in a portion of the city delayed for 2 hours during the afternoon of the 12th because of ice and wind. The Ohio Bell Telephone Co. reported 50 of its lines damaged by ice. Drainage from the rain again brought Toledo streams over their banks. A flood along Ten Mile Creek forced the suspension of W. P. A. projects in Jermain and Willys Parks.
Middleburg, Pa	11–12				1,500	Glaze	Streets and sidewalks dangerously slippery; numerous accidents due to skidding; several persons injured by falling.
Armstrong, Castro, Parmer, Randall, and Swisher Counties, Tex.	11–12				200,000	Wind and dust	Considerable soil blowing; some damage to winter wheat in Panhandle counties; light dust extended to the Texas coast on the 12th.
Ville Grove, Ill	12				200,000	Heavy rain and flood.	Overflow of Embarrass River caused much property damage.
Detroit, Mich	12					Glaze	Many branches broken from trees; telephone and power lines down, traffic delayed.
Danville, Ill., and vicinity	13				100,000	Heavy rain and flood.	The Vermillion River flooded the lowlands after 2 or 3 days heavy rain. 750 to 1,000 families forced from home. Several bridges washed out.
New England [2]	13			12		Blizzard	Highways impassable; planes grounded; shipping delayed. Snowfall averaged 12 inches with drifts 6 feet high in some sections.
Marquette, Mich., and vicinity.	14–15					Snow	16 inches, greatest 24-hour fall recorded for March. Nearly all highways blocked.
Minnesota, northern counties.	14–15				25,000	Snow, wind and flood.	Traffic seriously delayed. The rapid melting of snows together with a general break-up of ice in streams, resulted in high water in the Mississippi River and floods in the tributary streams below Hastings Dam to La Crosse, Wis. Lowlands in southeastern counties inundated. Damage to highways, buildings, and railroad property; soil washed; small loss to prospective crops.
Chicago, Ill., and vicinity	15			1		Wind	Trees uprooted; old buildings collapsed; hundred of windows broken and signs blown away; damage in thousands of dollars.
Wisconsin, northern portion [2]	15					Snow	Highways blocked; many communities isolated; drifts 10 to 15 feet deep.
Sunbury, N. C	16	3:10 a. m.	440	0	50,000	Tornado	3 persons injured; church demolished; residences and buildings damaged or destroyed.
Michigan, northern portion [2]	16					Blizzard	
Maple View-Adams [2] and from the Lake shore to Lowville, N. Y.	17–18					Snow	Light, deep snow of as much as 20 inches and over reported. Poor visibility caused motor accidents.
Duncan, Okla	24	4–5 p. m.	[1] 2½		30,000	Heavy hail	Small loss to crops; property damage, $30,000; path 7 miles long.
Seymour, Tex	24	6 p. m.			50,000	do	Property damage, $50,000; little crop loss.
Crosbyton, Tex	24				7,000	do	Property damage; no crop loss.
Cameron, Tex., and vicinity	25	6 p. m.	[1] 7			do	Roofs and automobile tops damaged; amount not estimated; small crop loss.
Nocona, Tex	25	7:25 p. m.	400	0	12,000	Tornado	1 person seriously injured; property damaged; small crop loss.
Clay County, Tex	27			0		do	2 houses damaged; 1 destroyed.
Patmos, Ark	28	6:30 p. m.			2,800	Wind and hail	$300 loss to crops; $2,500 property damage.
Union County, Ark	28	8–8:25 p. m.			22,500	Heavy rain and hail.	Roads washed; property damaged; path narrow and 8 miles long.
Crossett, Ark., and vicinity	28	9 p. m.	880–1,760		500	Heavy hail	Damage to trees and gardens; path 15 miles long.
Camden, Ark	28	P. m.			10,000	Heavy rain	Damage to streets and sewer systems.
Montrose, Ark., and vicinity	28	do			25,000	do	Damage to roofs and automobile tops over an area 2 miles square.
Oklahoma, Red River-Ringling	28		[1] 2–3		50,000	Hail	Small loss to crops; property damage, $50,000; path 30 miles long.
Winchester, Ark	29	3 p. m.	880		500	do	Property damaged.
Lamar and Red River Counties, Tex.	29	4 p. m.	[1] 2		41,000	Straight-line wind and hail.	Property damage, $35,000 from wind and $1,000 from hail; crop loss because of wind, $5,000.
Fort Valley, Ga	29				2,000	Heavy hail	Loss to peach crop.
Iowa [2]	29					Snow	Storm general throughout the entire State. Greatest depth, 10.5 inches, recorded at Marshalltown. Real traffic hazard on all streets and highways. Numerous accidents reported.
Chambers County, Ala	30				2,000	Wind	2 persons injured; property damaged.
East Brewton, Ala	30			0	8,000	Tornado	7 persons injured; property damaged.
Troy, Ala., vicinity of	30			0	5,000	Tornado and rain	6 persons injured; property damaged; loss to crops by washing.
Dinsmore, Fla., about 10 miles northwest of Jacksonville.	30	10:10 p. m.	100	4	20,000	Tornado	Several persons injured; 10 small houses demolished; other property damaged. The path about 100 yards wide at Dinsmore, where practically all damage occurred, then narrowed to about 17 yards at the eastern end; length of path 11 miles.
Sulphur Springs, Pugh, and Fountain Hill, Ark.	30	P. m.	440	0	2,000	do	Property damaged; timber blown over.
Hattiesburg, Miss	30					Electrical, wind, and hail.	Considerable property damage. Electrical service interrupted for 5 hours.
Daytona Beach, Fla	31	7:22–7:28 a. m	33	0	10,000	Tornado	3 persons slightly injured; several houses damaged; path 2 miles long.
Mountain Home, Ark	31	10 p. m.	34	1	3,000	do	Property damaged over a short path.

[1] Miles instead of yards.
[2] From press reports.

U. S. GOVERNMENT PRINTING OFFICE: 1939

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, March 1939

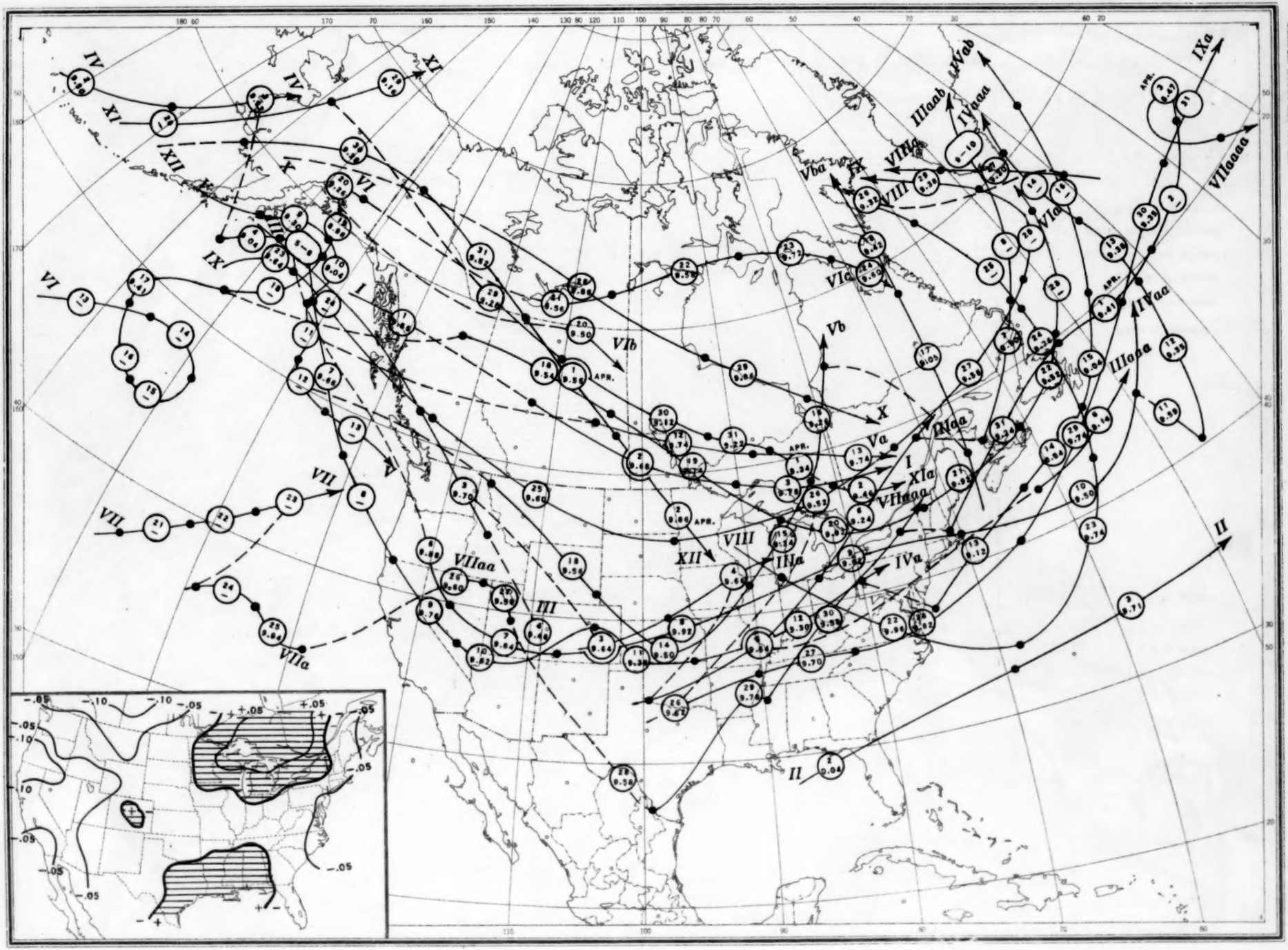
Chart II. Tracks of Centers of Anticyclones, March 1939. (Inset) **Departure of Monthly Mean Pressure from Normal**



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 7:30 p. m. (75th meridian time).

Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 7:30 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, March 1939. (Inset) Change in Mean Pressure from Preceding Month



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 7:30 p. m. (75th meridian time).

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, March 1939

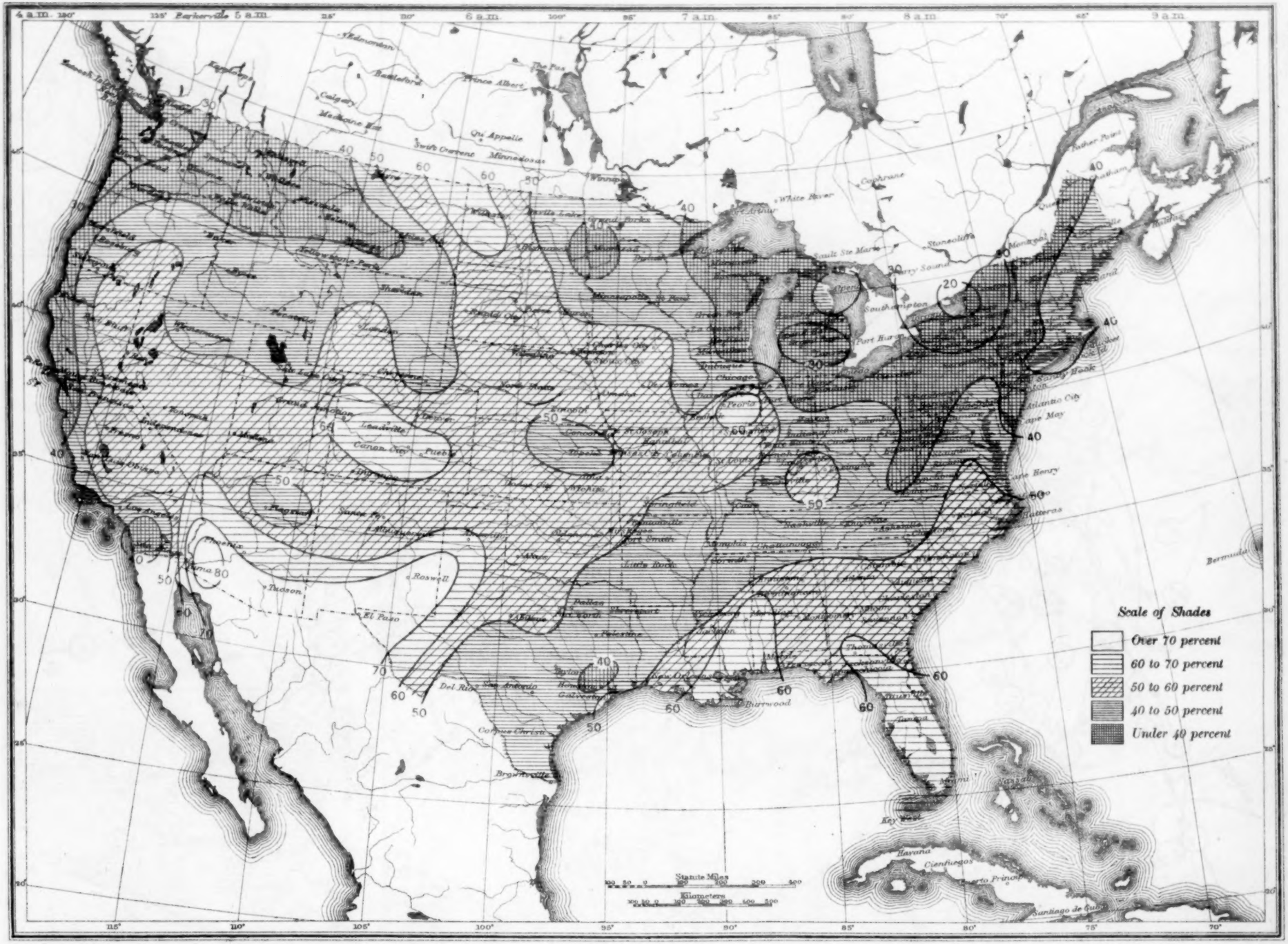


Chart V. Total Precipitation, Inches, March 1939. (Inset) Departure of Precipitation from Normal

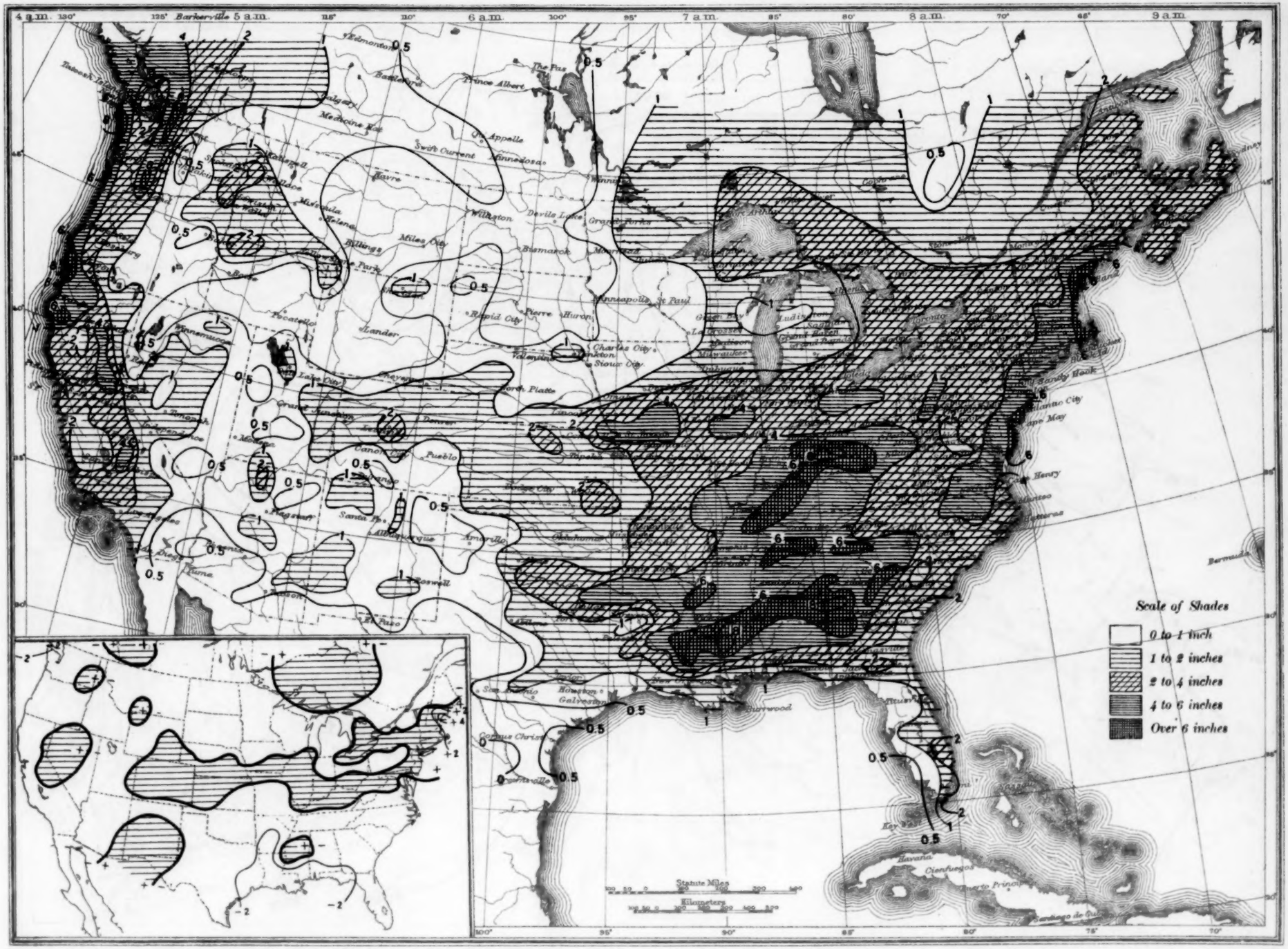


Chart VI. Isobars at Sea Level and Isotherms at Surface; Prevailing Winds, March 1939

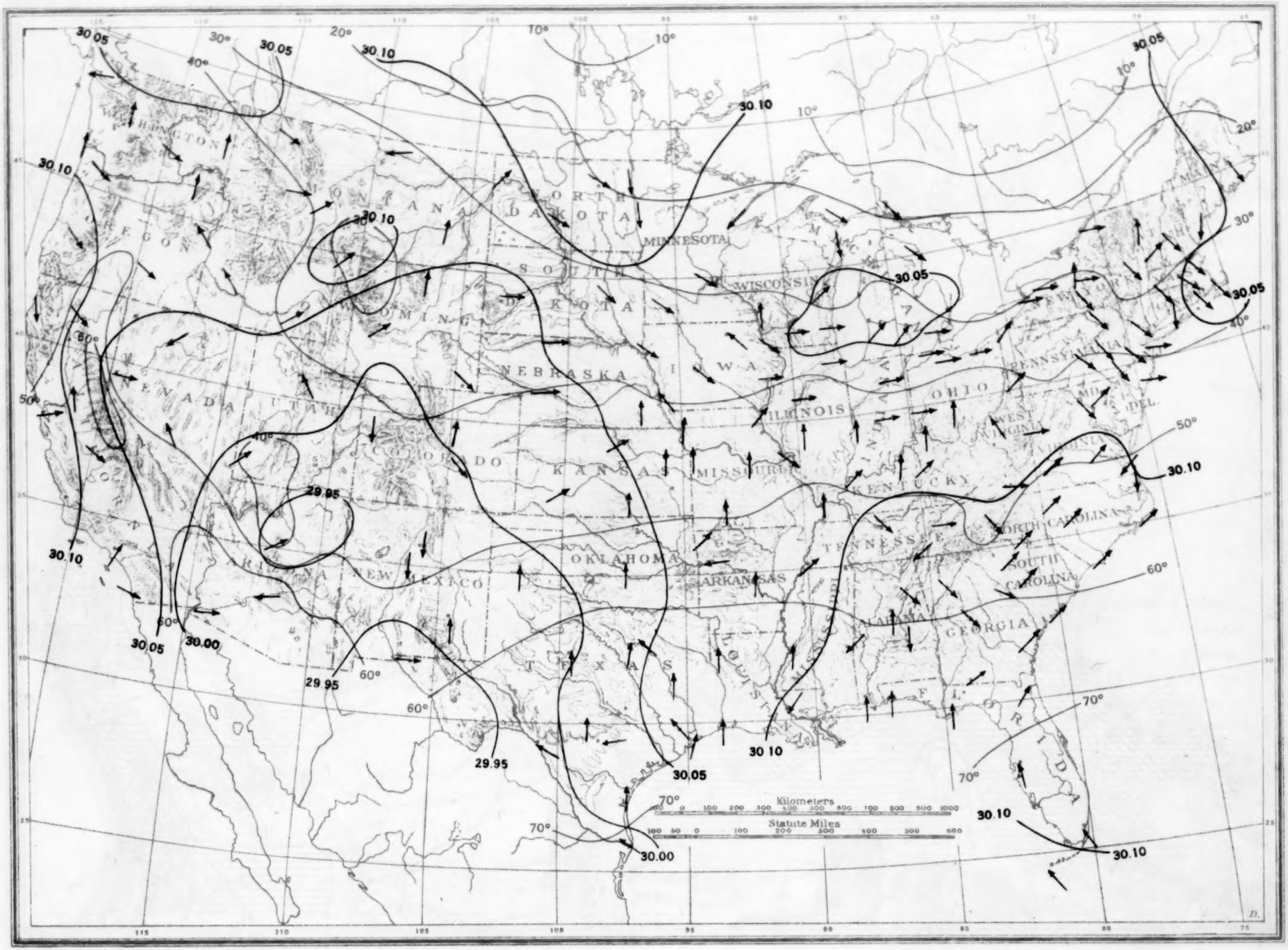


Chart VII. Total Snowfall, Inches, March 1939. (Inset) Depth of Snow on the Ground at 7:30 p.m., Monday, March. 27, 1939

Chart VIII. Isobars (mb) for 1,524 Meters (5,000 ft.) and Isotherms (°C.) and Resultant Winds for 1,500 Meters (m. s. l.) March 1939

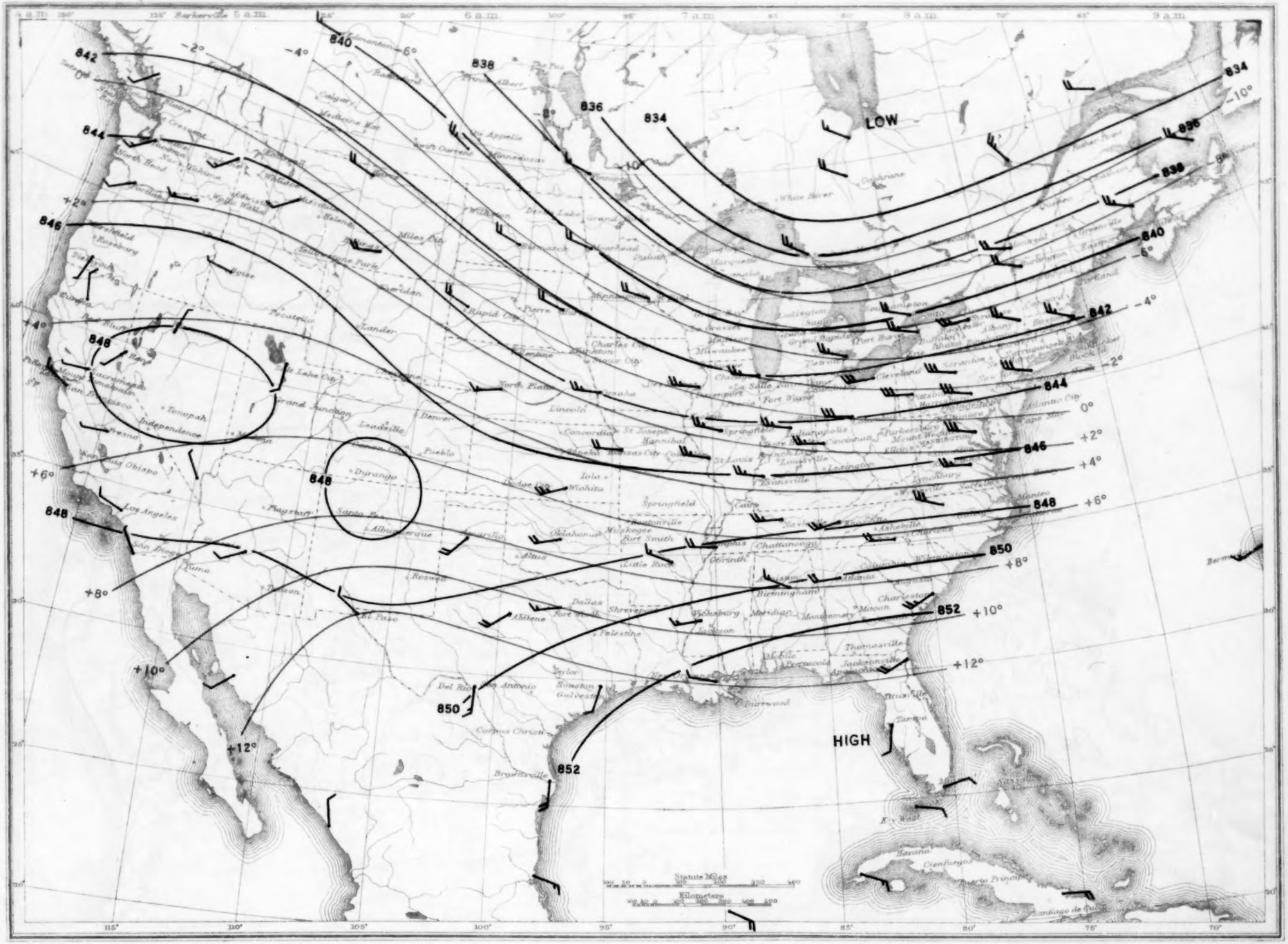


Chart IX. Isobars (mb) Isotherms (°C.) and Resultant Winds for 3,000 Meters (m. s. l.) March 1939

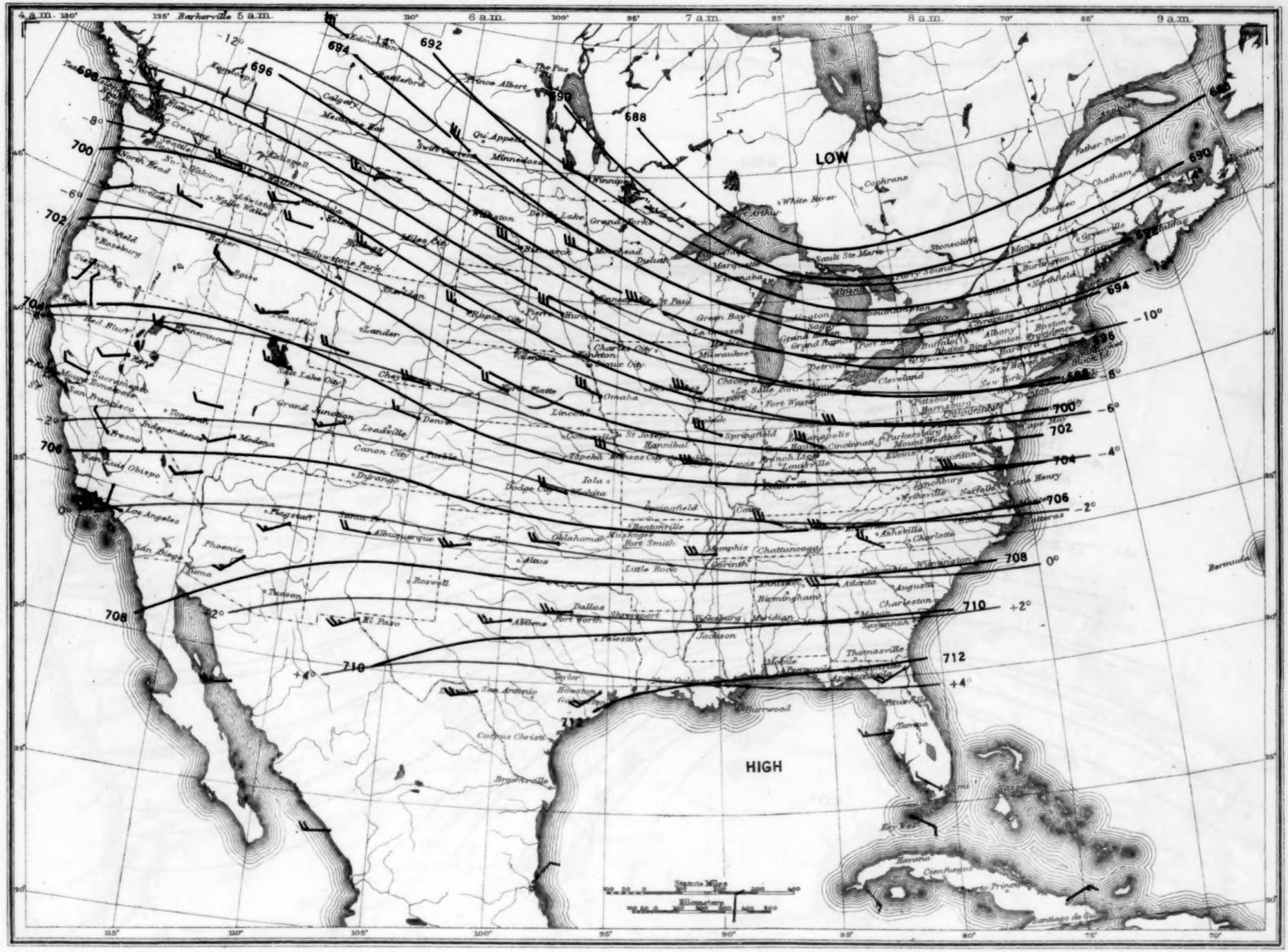


Chart X. Isobars (mb) Isotherms (°C.) and Resultant Winds for 4,000 Meters (m. s. l.) March 1939

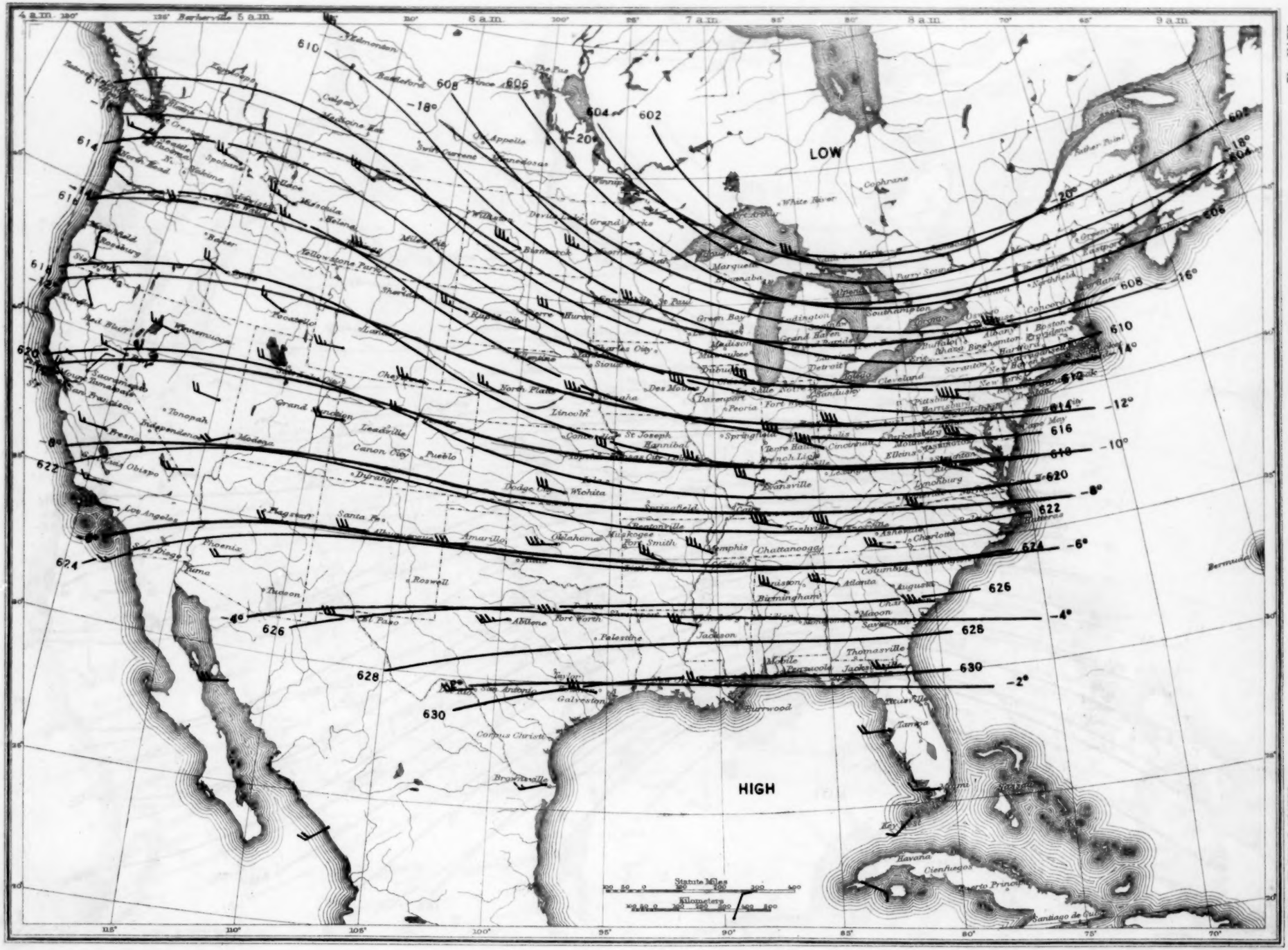


Chart XI. Isobars (mb) Isotherms (°C.) and Resultant Winds for 5,000 Meters (m. s. l.) March 1939

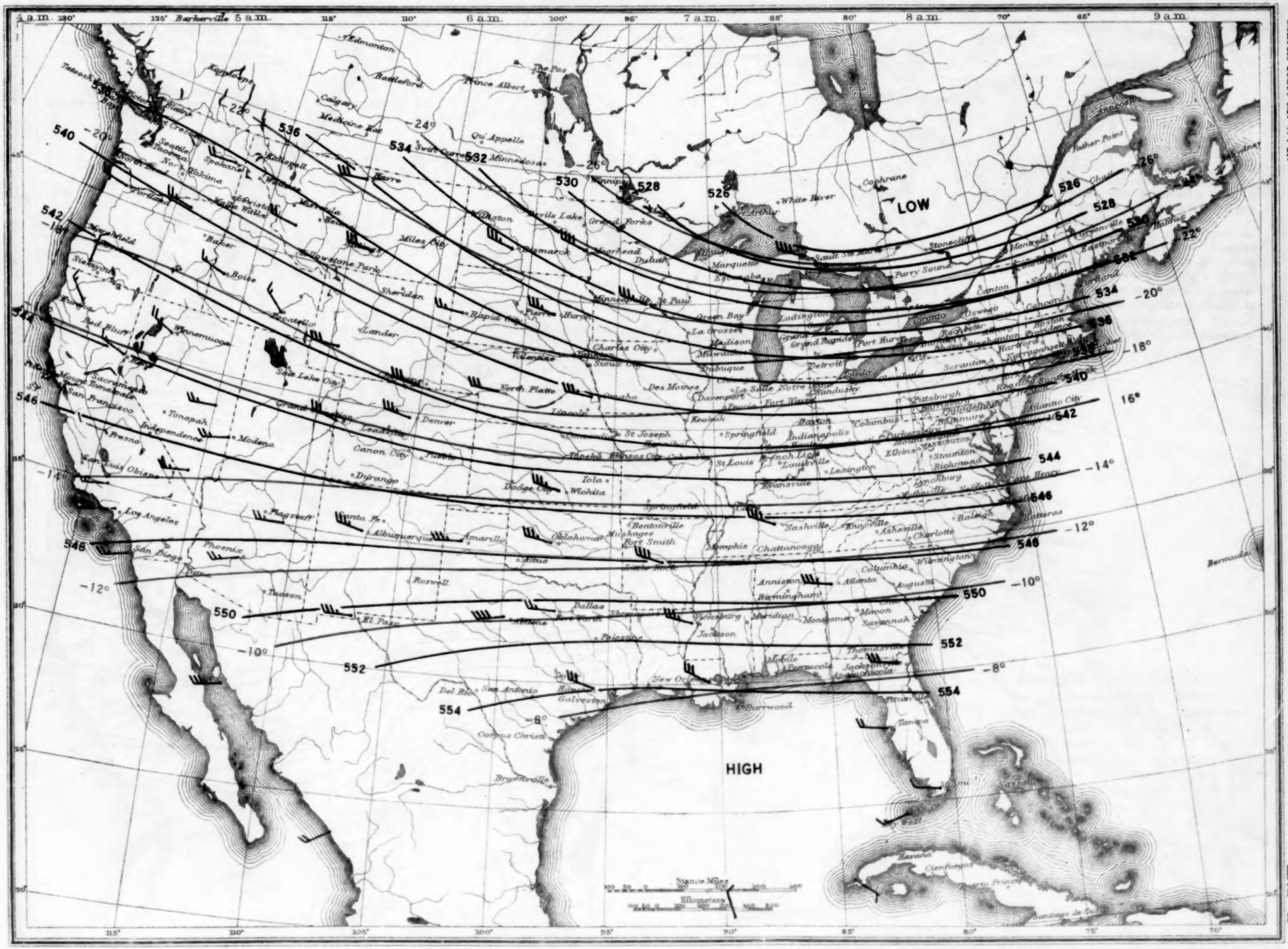


Chart XII. Mean Isentropic Chart, March 1939 (Potential Temperature 297° A.)

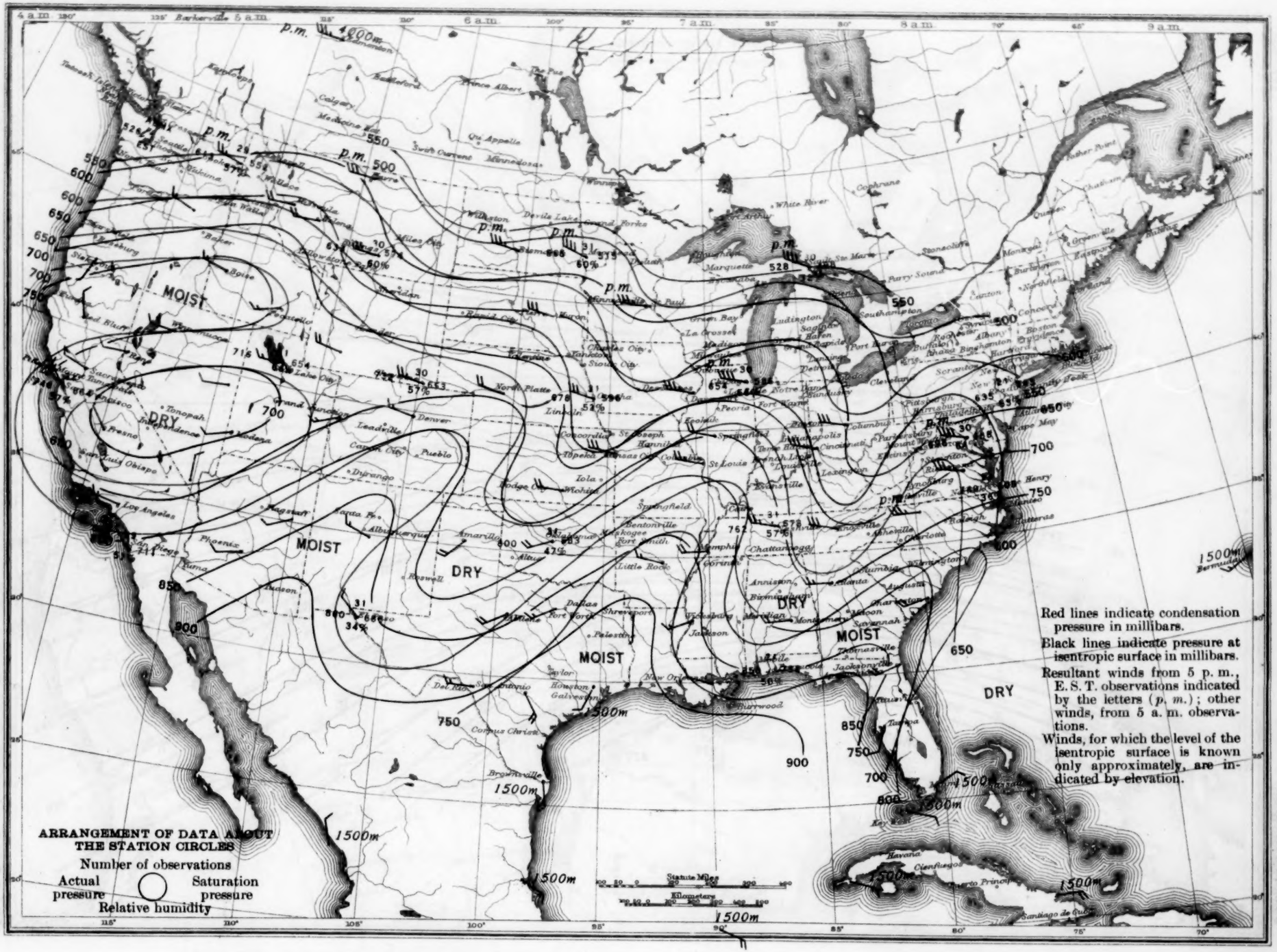
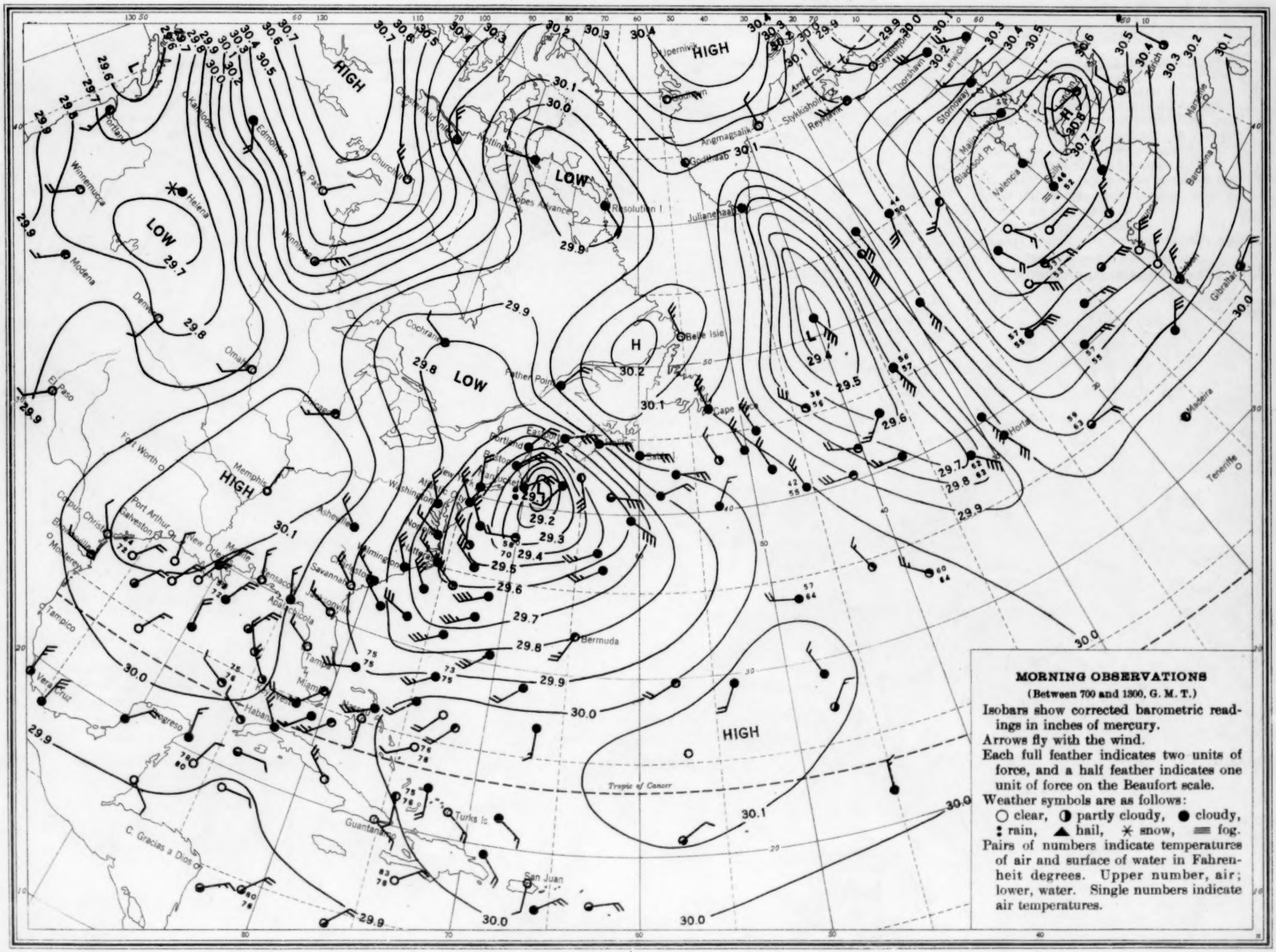

Red lines indicate condensation pressure in millibars.
Black lines indicate pressure at isentropic surface in millibars.
Resultant winds from 5 p. m., E. S. T. observations indicated by the letters (p. m.); other winds, from 5 a. m. observations.
Winds, for which the level of the isentropic surface is known only approximately, are indicated by elevation.
ARRANGEMENT OF DATA ABOUT THE STATION CIRCLES
Number of observations
Actual pressure
Saturation pressure
Relative humidity
MOIST
DRY
1500m
Statute Miles
Kilometers

Chart XIII. Weather Map of North Atlantic Ocean, March 13, 1939

(Plotted from the Weather Bureau Northern Hemisphere Chart)



MORNING OBSERVATIONS

(Between 700 and 1300, G. M. T.)

Isobars show corrected barometric readings in inches of mercury.

Arrows fly with the wind.

Each full feather indicates two units of force, and a half feather indicates one unit of force on the Beaufort scale.

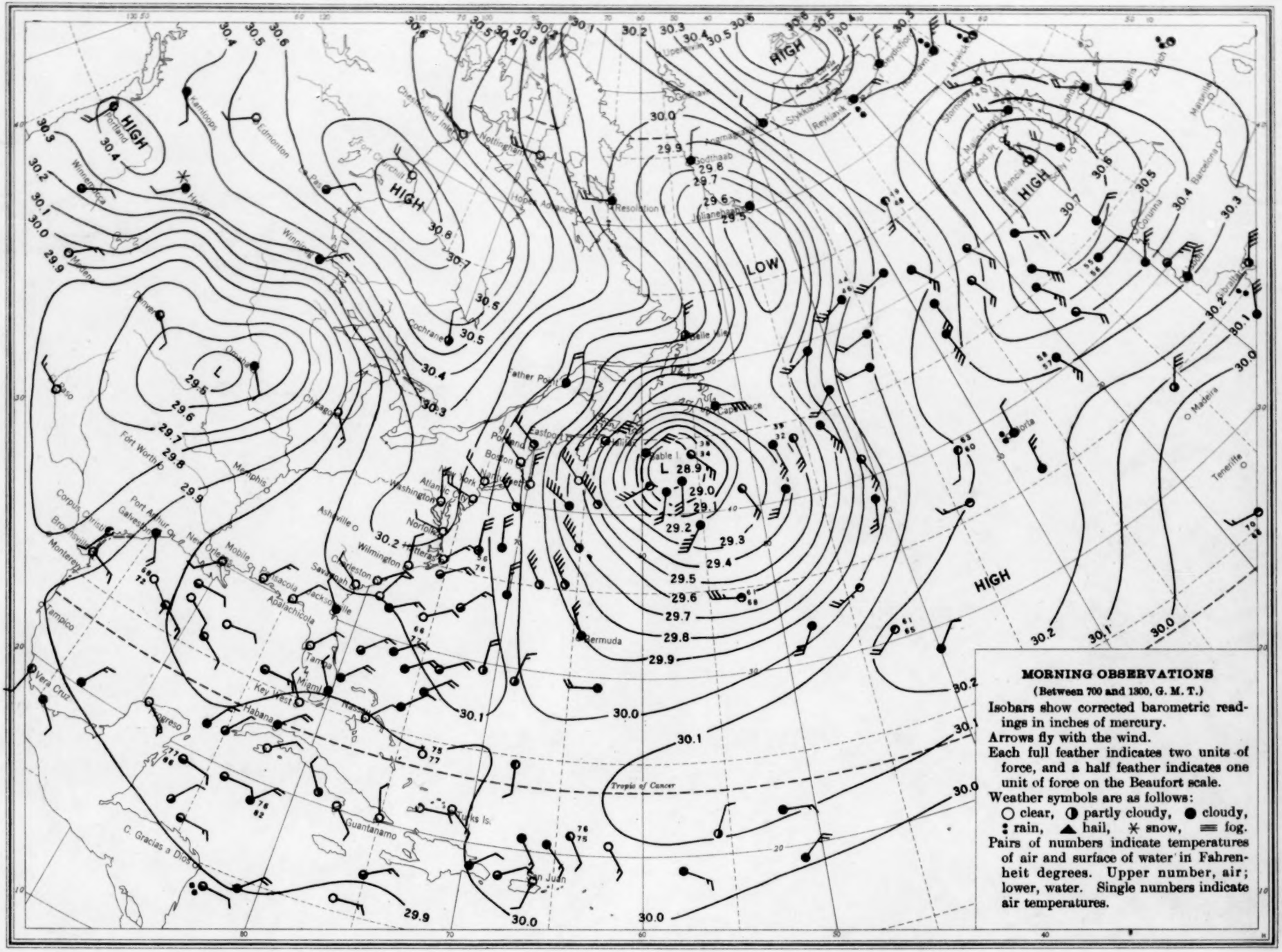
Weather symbols are as follows:

○ clear, ◑ partly cloudy, ● cloudy, ⁝ rain, ▲ hail, ✳ snow, ≡ fog.

Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water. Single numbers indicate air temperatures.

Chart XIV. Weather Map of North Atlantic Ocean, March 14, 1939

(Plotted from the Weather Bureau Northern Hemisphere Chart)



MORNING OBSERVATIONS

(Between 700 and 1300, G. M. T.)

Isobars show corrected barometric readings in inches of mercury.

Arrows fly with the wind.

Each full feather indicates two units of force, and a half feather indicates one unit of force on the Beaufort scale.

Weather symbols are as follows:

○ clear, ◑ partly cloudy, ● cloudy, ⁝ rain, ▲ hail, ✳ snow, ≡ fog.

Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water. Single numbers indicate air temperatures.